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THE SLIP CASTING OF CLAY POTS FOR THE MANUFACTURE OF OPTICAL GLASS AT THE NATIONAL BUREAU OF STANDARDS

By RAYMOND A. HEINDL, GORDON B. MASSENGALE AND LOUIS G. COSSETTE

Introduction

Approximately 28 years ago A. V. Bleininger[1] reported the results of the first work undertaken at the Pittsburgh, Pa., station of the Bureau of Standards for the development of a suitable refractory clay slip cast pot to be used as a container in the manufacture of optical glass. Stimulated by World War I, several other papers[2] dealing with this subject were published during the succeeding five years. In the years between World Wars I and II the manufacture of optical glass continued on a small scale requiring about 70 clay pots which were made by the Refractories Section. It was, however, because of this production that the Bureau was able to expand quickly its clay pot manufacturing facilities and produce 2300 units annually. Also, the excellent opportunity afforded for observing the pots during use in the glass manufacturing plant led to the study and correction of defects in the pot structure which improved the quality of the glass. For example, the development of a pot containing a lining of low porosity and of a thimble having a coating of slip similar to that of the pot lining occurred during that period.

This paper will describe those and other developments as well as the expansion which materialized with the beginning of hostilities in Europe in 1939.

Furthermore, it was because of the small scale production that representatives from numerous glass companies both here and abroad, sought information relating to the manufacture of clay pots and studied the methods of production for application in their plants. Among those represented were several domestic manufacturers of glass products, Research Enterprises, Ltd., Leaside, Ontario, Canada, which furnished much of the glass for the Canadian government, Australian Window Glass, Melbourne, Australia, through the Munitions Department of the Australian government, and later also a representative of the Chinese government.

Plant

1. *Pot casting.* The section of the plant allotted to the casting of the pots is the same as that referred to by Geller and Finn[2]. The two blungers, each of which was large enough only for the slip required for one 650-pound pot, were superseded by one two-stirrer blunger in which ample material may be mixed for casting four pots. The inside of the tank is 7 ft. 5 in. long, 3 ft. 3 in. wide and 2 ft. 10 in. high. Each stirrer has six round steel bars 27 in. long by 1¼ in. in diameter fastened vertically to two cross members 31 in. long. One of the discharge outlets was reduced from 4 in. to 2 in. for use in making a fluidity or flow test of the clay slip. With a 2½ hour overlapping of two shifts, eight pots can be cast during a 10-hour period. A ball mill is used for mixing 500 pounds of a finely ground slip which, when finished, is stored in a large capacity single blade blunger. The two machines were already available. Racks were provided for the storage of 44 plaster of paris molds. Electrical heater units suspended in the shell of the mold provided a temperature of about 75°C for speeding up the drying of the molds. A scale suspended from an overhead trolley, which paralleled the small pot material storage bins, was installed to speed up and make for more accurate weighing.

2. *Pot shell crushing.* New space was allotted for setting up the machinery required for cleaning, crushing, grinding and screening the reclaimed pot shell. The crushers and 4-deck shaker screen are connected by an endless belt, see Fig. 1. No work is required other than feeding the reclaimed chunks of pot shell, cleaned of adhering glass, to the jaw crusher except emptying the hopper carts into which the grog is discharged, after screening into three fractions. When the need arises, the third or finest fraction is diverted through a smaller 2-deck shaker screen and further separated into useful fractions. Sheet iron casings were placed around the con-

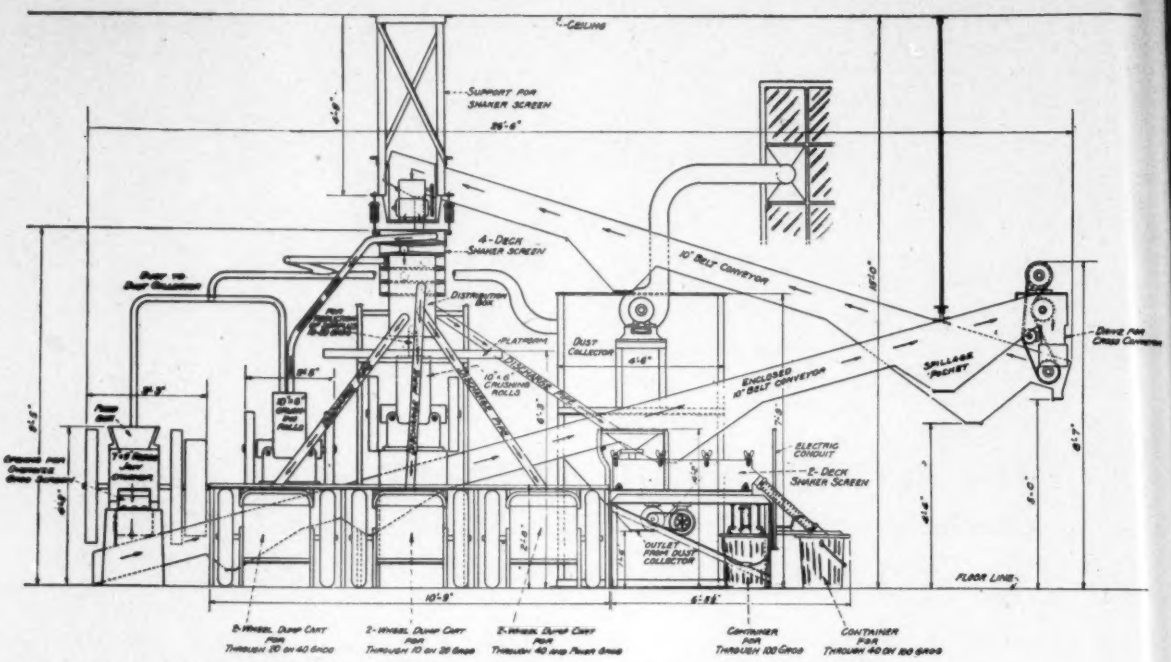

Fig. 1. Line drawing of plant for crushing, grinding and screening reclaimed pot shell.

veyor and machinery and these connected to a dust collector by pipes located at strategic places in the system.

3. *Storage.* A space approximately 45 x 55 ft. is used for the drying and storage of the pots. By placing the pots in tiers three high a stock of about 275 may be maintained, representing an 8 to 9 weeks supply at full production of the glass plant. The pots are removed from the plaster of paris bases and placed on 40-in. x 40-in. skids by means of an overhead trolley and hoist. A portable elevator or stacker with an electrically operated lift platform is used for placing the pots in the tiers.

Eleven bins were built of concrete for the storage of the clays and grog. Forty tons of clay may be stored in the largest bins.

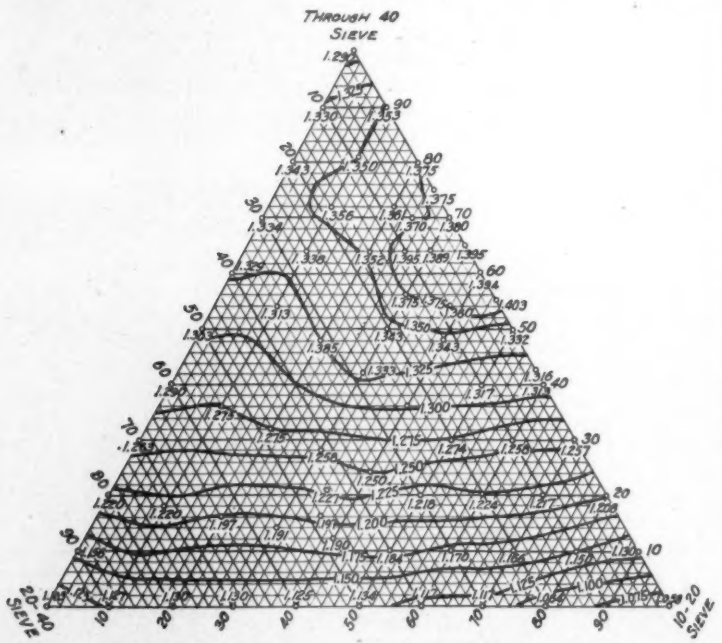

Fig. 2. Triaxial diagram for selection of combinations of grog sizes of desired densities.

Manufacture of Pots

1. *Types.* Two types of pots are in regular production. These differ only in that one has a low porosity lining[3] approximately ⅛-inch thick. The approximate dimensions of the pot are as follows: diameter at the top outside 35 inches, bottom outside 32½ inches, wall thickness at the top 2¾ inches, depth 24¾ inches and thickness of bottom 3⅜ inches. A shoulder completely around the outside for convenience in handling the pot is 14 inches from the top. The batch composition of the body until the end of 1944 closely approached that referred to by Geller and Finn[2] as No. 332. However, for many years reclaimed pot shell has been substituted for the whiteware bisque. Also during the closing months of 1944 Delaware kaolin was no longer available, which necessitated its substitution with Georgia kaolin. All the clays are received in finely pulverized or air-floated form instead of in lump form as formerly.

Since the grog used in the pots is screened into three fractions, namely through No. 10 and retained on the No. 20, through No. 20 and retained on the No. 40, and through the No. 40, the triaxial diagram shown in Fig. 2 was pre-

pared. The density of various combinations of the fractions was determined and these are indicated on the diagram. A portion of the grog passing through the No. 40 screen is further separated into two fractions, namely through No. 40 and retained on a No. 100 screen, and through a No. 100 screen. The total grog[4] in the pot batch was not significantly changed, but the percentages of the sizes were changed and one additional fraction added as indicated in table 1.

TABLE 1.

PERCENTAGES AND FRACTIONS OF GROG USED IN REFRACTORY POTS.

Screen Size[a]	*Formerly*	*Present*
	Per Cent	*Per Cent*
Through 10 on 20	35	34
Through 20 on 40	45	30
Through 40 on 100	0	18
Through 40	20	18

[a]Screen numbers refer to U. S. Standard Series.

The bulk density of the mixture of grog only as formerly used was 1.197, but that of the present composition is 1.30.

The complete pot batch as now used is given in table 2, and the chemical composition of reclaimed, cleaned and crushed pot shell is given in table 3. A few pots were cast in which the silica was increased in steps up to 69 per cent, but their manufacture was discontinued

TABLE 2.

PERCENTAGE COMPOSITION OF REFRACTORY POT BATCH, AND PYROMETRIC CONE EQUIVALENT.

Material	*Percentage*	*Pce Cone*
North Carolina kaolin	13	34
Georgia kaolin	9	35
Tennessee No. 5 ball clay	10	31
Kentucky No. 4 ball clay	10	32
Maine felspar	5	10
Grog (reclaimed pot shell)	53	32
Silicate of soda[a]	0.025	—
Sodium carbonate[a]	0.012	—

[a]With only slight variation from day to day, to 100 pounds of dry batch are added 57 cc of a 10 per cent solution of sodium carbonate, 115 cc of silicate of soda (Philadelphia Quartz Company's "S" brand or equivalent) and 2.56 gallons of water.

in favor of those of the regular composition. Other pots were made in which one or more of the clays were eliminated in favor of larger percentages of the remaining clays. For example, the Kentucky ball clay was substituted for the Tennessee ball clay and vice versa; the North Carolina kaolin was replaced with either the Delaware or Georgia kaolins and so on. No particular difficulty was experienced with the resulting casting slip or finished pots, indicating its ready adaptability to any reasonable change in composition.

The blunger is loaded in approximately 35 minutes by controlled discharge from portable hoppers, three of which are required to fill the mill of about 3,000 pounds capacity. The top of the blunger tank is covered except for an opening into which the lower edge of the hopper fits. A low vacuum is maintained in the tank to minimize the dust during filling. A water meter and an

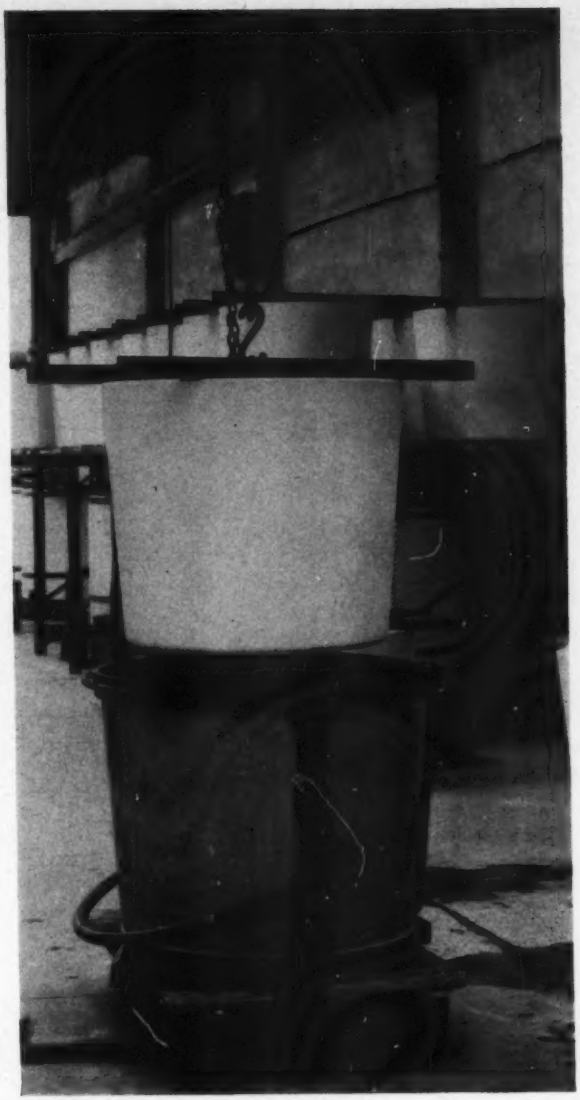

Fig. 3. Core of pot mold ready to be lowered into empty clay slip receiver.

ammeter are used for measuring the water and indicating the consistency of the slip, respectively. The slip is blunged for three hours before casting into the molds. The stirrers, which rotate in the same direction at 30 rpm, are completely below the surface of the slip during

TABLE 3.

CHEMICAL COMPOSITION OF USED POT OR THE RECLAIMED POT SHELL.

	Per Cent
SiO_2	59.5
Al_2O_3 (by difference)	35.6
Fe_2O_3	.8
Na_2O	.7
TiO_2, ZrO_2, etc.	.8
K_2O	2.2

operation of the blunger in order to prevent continual trapping and mixing of air into it. Just before casting,

TABLE 4.

COMPOSITION[a] OF REFRACTORY CLAY POT LINING SLIP.

	Per Cent
North Carolina kaolin	9.2
Georgia kaolin	6.4
Kentucky ball clay	7.8
Tennessee ball clay	7.8
Maine felspar	4.6
Grog (reclaimed pot shell)	32.1
Dust[b]	32.1

[a]To each 100 pounds of dry ingredients are added 275 cc of sodium silicate ("S" brand), 140 cc of a 10 per cent solution of sodium carbonate and about 3.25 gals. of water. After ball-milling 20 hours, the slip is stored in a single blade blunger.

[b]Obtained from dust collector connected with the grog crushing plant.

a fluidity test of the slip is made by timing the filling of a 14-quart bucket from the 2-inch discharge outlet. With the machine in operation, and under the conditions existing, the time required ranged from 9 to 10 seconds. For the unlined pots about one-half hour is required for placing the four molds in the casting pit, filling and removing them. About one hour is required for casting the four lined pots. The cores are removed from the unlined pots within 12 to 14 hours after casting and from the lined pots within 6 to 10 hours, depending on the humidity of the atmosphere. The one piece shell is removed from the pots three to four days later.

The composition of the slip used as the lining of the clay pots is given in table 4.

The sequence followed in the application of the lining to a pot is illustrated in Fig. 3 to 7, inclusive. Briefly, Fig. 3 shows the core suspended above the empty slip receiver; Fig. 4 shows the slip being poured into the receiver after the core had been lowered and locked into position to prevent it from floating; Fig. 5 shows the coated core suspended again above the receiver to permit surplus slip to be lightly scraped from the core; Fig. 6 shows the coated core being lowered into the shell; Fig. 7 shows the casting of the pot around the lining. The mold is slightly tilted during the initial stage of casting and the slip permitted to flow from only the lowest of the three openings in the distributing reservoir. This arrangement causes the slip to flow uphill underneath the core and there is less tendency of entrapping air bubbles between the lining and pot.

The mold is brought level after the bottom is filled, the gates of the other two openings in the reservoir opened and the mold lightly rocked until the pot is completely cast. The rocking is accomplished by balancing the cradle on which the mold rests on a 1-in. pipe. It serves the dual purpose of leveling the slip as it is cast and of freeing air trapped in the slip during the casting operation.

The core remains in the lining slip for six minutes before being transferred to the shell. Pots are also cast with linings ¼ inch or more in thickness composed of double and of triple layers. In such cases the core remains in the slip for 3 minutes for the first coating and for an additional 5 minutes for the second coating and also for the third if it is applied. The coatings or layers are applied by removing the core from the container of slip in which it is immersed and repeating the entire operation already described for casting the lining slip to the core. The core is removed from the completed lined pot, as shown in Fig. 8. It was found advisable to remove the cores as soon as practicable in order to prevent cracking of the lining.

The reason for the double and triple coating is to eliminate the possibility of air bubbles extending through the pot bottom lining. When used with the more corrosive glasses the pot with the single coating would be apt to leak glass after the very thin wall of the air bubbles, if present, is destroyed. These bubbles are not evident on examination of the unfired pot. The corrosive glasses, however, are successfully fined in the pots lined with multiple layers or coatings.

Several pots were cast with a lining in which synthetic mullite was used in place of the reclaimed pot shell grog. The ingredients of this slip other than the mullite were alumina and clay in the approximate alumina-silica ratio of mullite. Although the lining developed no cracks during drying, it did so seriously during firing at about 1400° C that the usefulness of the lining was nullified. Furthermore, this temperature was too low to develop the quantity of mullite[5] desired in the lining.

Fig. 4. Clay slip being poured into receiver after core has been lowered and locked into position.

2. *Finishing and drying.* As soon as the shell is removed the rim is leveled by cutting off the surplus material. As a precaution the inner edge of the lined pot is rounded to minimize cracking at the rim. Fig. 9 shows a pot in the foreground which has the rim in three stages of completion. Very little is done to the inside of the pot as there is a tendency to start incipient cracking when smoothing with a trowel. This cracking though

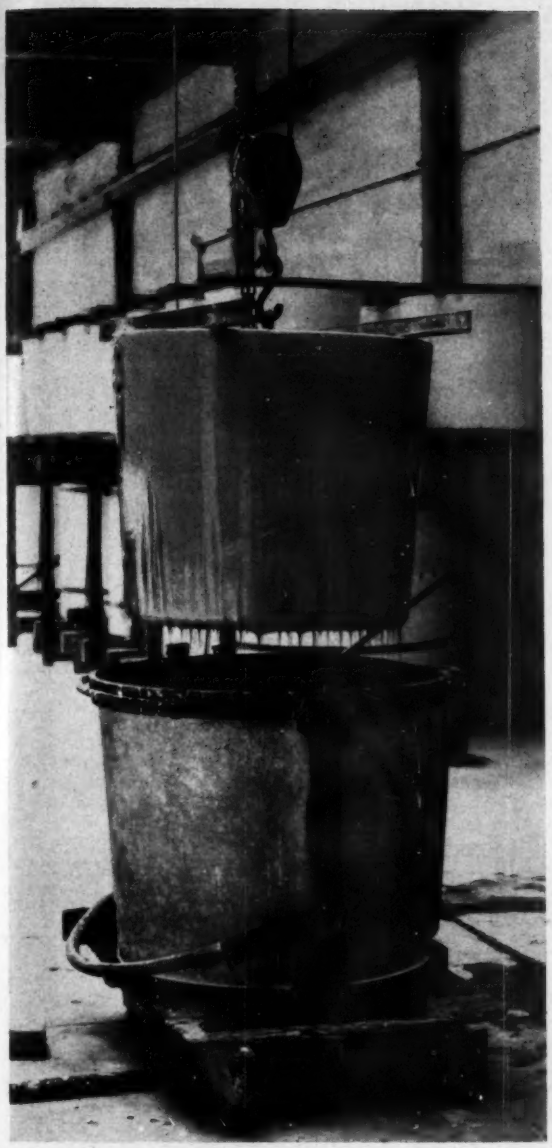

Fig. 5. Excess slip draining from the coated core after having remained in the clay slip for 6 minutes.

invisible in the dry state, may develop into "nuisance" cracks during heating of the pot to high temperatures.

The pots remain on the plaster of paris bases of the mold for a total of nine days, after which they are removed to a 40 x 40 in. skid. The pots require about one month to dry during the time of the year when the buildings are heated and about two weeks longer during the spring and summer months. Drying with humidity control is not practiced, but proceeds under ordinary atmospheric conditions while the pots are in storage. During the months in which the humidity is low, cloth is placed around the rim of the finished pot for 10 days to prevent too rapid drying.

3. *Difficulties and remedies.* (a) Cracking. There are a number of different causes of cracks which may appear between the time the pot is cast and dry. One type of crack which appeared in the inside corner of the wet pot almost immediately after removal of the core was eliminated by withdrawing the core two or three hours earlier or as soon as the danger of slumping of the pot no longer existed.

A type of crack which appeared across the middle of the inside bottom of the pot from one to three days after removal of the core was eliminated by making certain that the base section of the mold was damp before using. The crack started from the outside and gradually extended its way upward.

Cracks which started at the heel of the pot caused large sections of the outer pot wall to be sheared off. The cause was eliminated by having the plastic clay, which seals the opening between the circumference of the base and of the shell, of a fairly stiff consistency to reduce its shrinkage to a minimum and to have ample clay forced into position and feather-edged to meet the plaster. Furthermore, the base of the mold as well as the surface of the sealing clay is coated with a refractory dust to prevent possible sticking of the slip during the initial stages of drying of the pot.

Radial cracks across the inside bottom were so called because of their tendency to resemble the spokes of a wheel; that is, they radiated more or less from the center of the bottom. Fig. 7 shows the 3-opening distributor through which the pot slip flowed. If the slip was permitted to pour through the three openings simultaneously before the bottom of the mold was completely filled,

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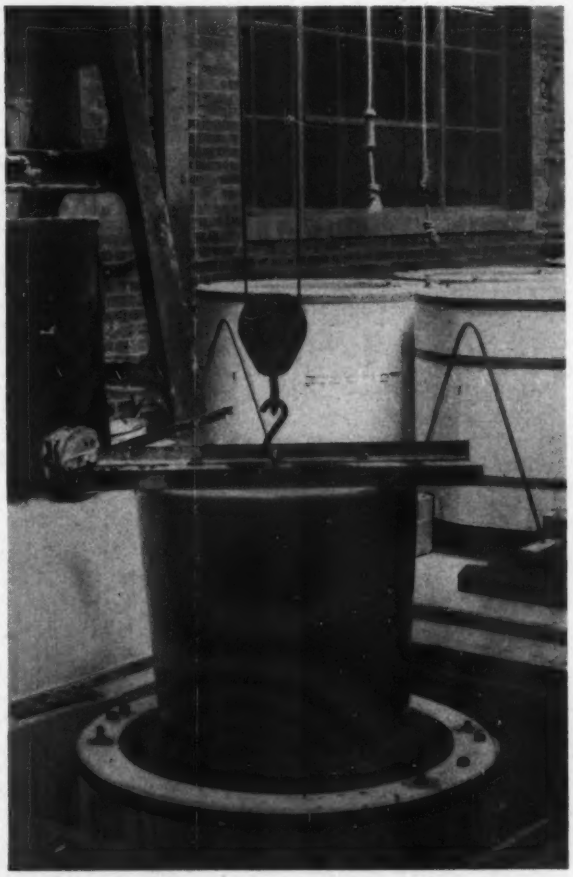


Fig. 6. The slip coated core being lowered into the shell of the mold.

AFTER 11 YEARS A. C. S. RETURNS TO BUFFALO FOR ITS 48th ANNUAL MEETING

On Sunday, April 28, the forty-eighth Annual Meeting of the American Ceramic Society will convene at the Hotel Statler in Buffalo, New York.

It was in Pittsburgh in April 1944 that the last full annual meeting of the Society was held. Hence, it is about two years since all divisions have been able to assemble. In addition to the fact that this gathering will mark the resumption of the long established practice of an annual meeting for the entire Society interrupted by O.D.T. travel restrictions, it is also interesting to note that the A.C.S. returns to Buffalo for its annual convention after a lapse of eleven years.

While details of entertainment and possible plant trips are unavailable as this issue goes to press, it is understood that these matters are well in hand by the Local Committees and it can be stated that as far as the Glass Division Program is concerned, a very interesting and extensive group of papers have been developed by the Division's program chairman, Oscar G. Burch of Owens-Illinois Glass Company.

The Local Committee personnel is as follows:

Honorary Chairman, Dean M. E. Holmes, New York State College of Ceramics, Alfred, N. Y.; General Chairman, M. H. Berns, Electro Refractories & Alloys Corp., Buffalo, N. Y.; Local Section Chairman, H. R. Lillie, Corning Glass Works, Corning, N. Y.; Entertainment Committee, Chairman: G. J. Easter, Carborundum Co., Niagara Falls, N. Y., F. D. Bowman, Carborundum Company, Niagara Falls, N. Y., A. T. Hinckley, Oldbury Electro-Chemical Co., Niagara Falls, N. Y. and R. L. Van Peursem, Rochester Institute of Technology, Rochester, N. Y.; Ladies' Entertainment Committee, Chairman: Mrs. H. S. Schroeder, Niagara Falls, N. Y., Mrs. R. E. Gould, Hamburg, N. Y., Mrs. M. H. Berns, Hamburg, N. Y.; Equipment and Supplies Committee, Chairman: H. R. Failmezger, Victor Insulators, Inc., Victor, N. Y., K. E. Stettinius, Lapp Insulator Co., Inc., Le Roy, N. Y., H. J. Struebing, Electro Refractories & Alloys Corp., Buffalo, N. Y.; Service Committee, Chairman: R. M. Campbell, New York State College of Ceramics, Alfred, N. Y.; Publicity Committee, Chairman: G. S. Diamond, Electro Refractories & Alloys Corp., Buffalo, N. Y.; Ceramic Camera Club Committee, Chairman: J. P. Mulroy, Buffalo, N. Y.; Exhibit Committee, Chairman: S. F. Walton, Exolon Co., Tonawanda, N. Y.; Plant Visitation Committee, Chairman: R. E. Gould, Buffalo Pottery, Inc., Buffalo, N. Y.; School Dinners Committee, Chairman: H. S. Schroeder, Carborundum Co., Niagara Falls, N. Y.

A meeting of the Institute of Ceramic Engineers has been scheduled for Sunday, the 28th, at 1 o'clock.

The President's reception will take place at 8 P.M. on the same day and will be followed by the Induction of Officers, the Induction of Fellows and the Award of the Binns Medal and a life membership in the Society to Professor Arthur S. Watts of Ohio State University.

About the only deviation noted from the usual pattern followed for the Annual Meeting is that the President will not deliver his address at the Sunday evening dinner and reception, but will do so at the close of the business session Monday afternoon. It is reported that President Tefft plans to make his talk quite brief.

The Edward Orton Lecture will be delivered by Dr. George Clark of the University of Illinois and an outstanding highlight of the Meeting will be a testimonial dinner to Ross C. Purdy, who retires this year as General Secretary of the Society after many years of conscientious and constructive service. This dinner will take place Monday evening, the 29th.

Preceding the meetings of the various Divisions, a General Session-Engineering Conference is scheduled to be held in the Ball Room of the Hotel Statler on Monday. The outline of this session follows:

Monday Forenoon, April 29, 9:45 A.M.-12:15 P.M.

1. **Business Session.**
   Presiding Chairman: C. Forrest Tefft, President of The American Ceramic Society.
   Engineering Conference Sponsored by the Institute of Ceramic Engineers.
   Presiding Chairman: T. A. Klinefelter, Southern Experiment Station, U. S. Bureau of Mines, Tuscaloosa, Ala.
2. **Production with Freedom.** *By Edward T. Cheyfitz: Motion Picture Association, Washington 5, D. C.*
3. **Symposium on Ceramic Industry in Germany.** The participants in this symposium have recently returned from Germany and will present impressions of various branches of the ceramic industry in that country.
   (1) Electrical Insulators. *By Hans Thurnauer: American Lava Corporation, Chattanooga 5, Tenn.*
   (2) Flat Glass. *By M. C. Gregory:*
   (3) Refractories. *By Gilbert E. Seil: Day & Zimmermann, Incorporated, Packard Bldg., Philadelphia 2, Pa.*
   (4) Whiteware. *By J. W. Whittemore: Virginia Polytechnic Institute, Blacksburg, Va.*

General Luncheon—12:30-2:15 P.M.
Niagara Room

Luncheon Address.

4. **Ceramics in Communications.** *By R. M. Burns: Bell Telephone Laboratories, Murray Hill, N. J.*

Monday Afternoon, April 29, 2:30-4:30 P.M.

Presiding Chairman: C. Forrest Tefft, President of The American Ceramic Society.

5. **Human Engineering in a Democratic, Atomic Age.** *By J. E. Walters: President, Alfred University, Alfred, N. Y.*
6. **Management Engineering.** *By L. W. Wallace: Trundle Engineering Company, Cleveland, Ohio*
7. **Atomic Energy.** *By Marion L. Pool: Department of Physics and Astronomy, Ohio State University, Columbus 10, Ohio*
8. **Report of the President of The American Ceramic Society.** *By C. Forrest Tefft, Claycraft Company, Columbus 16, Ohio*

Unfortunately, THE GLASS INDUSTRY is unable to print the program of the Refractories Division since the list of papers of the Division has not been received in time for inclusion in this issue. Committee C-14 of the American Society for Testing Materials will meet Wednesday afternoon, May 1. The General Session program and the

membership of this Committee, together with the Glass Division daily program, follows:

GLASS DIVISION PROGRAM

Tuesday Forenoon, April 30, 9:00 A.M.-12:00 M. Chinese Room

1. Changes in Distilled Water Stored in Glass Ampuls. *By A. L. Hinson, D. C. Smith, and J. F. Greene: Kimble Glass Company, Vineland, N. J.*

I. *Methods:* (*a*) Determination of pH of distilled water by colorimetric and electrometric methods; and (*b*) determination of solids in water. II. *Results:* The increase of pH and total solids is shown for a series of ampul glasses, with and without autoclaving, for storage periods up to two years.

2. Dielectric Properties of Glasses at Ultrahigh Frequencies and Their Relation to Composition. *By L. Navias and and R. L. Green: General Electric Company, Research Laboratory, Schenectady 5, N. Y.*

The dielectric constants and dielectric losses of 100 glasses of a wide range of composition have been measured at 10 cm. and 3 cm. wave lengths by the resonating cavity method (3,000 and 10,000 megacycles, respectively). The power factors calculated from these measurements have been correlated with the compositions of these glasses. By this method, it has been possible to propose a qualitative explanation of the mechanisms producing energy absorption and dielectric losses in the microwave range. These mechanisms are determined by the nature of the bonds joining atoms and ions in the randomly oriented atomic networks of glasses.

The rigid and continuous networks of SiO_2 and B_2O_3 glasses are relatively transparent to centimeter wave lengths. Energy absorption and dielectric losses are low. The addition of network-modifying oxides yields glasses showing greater energy absorption due to the oscillation of the interstitial ions thus introduced. Increasing the content of any one of these ions in a glass results in higher losses while the coexistence of a variety of these ions generally results in lower losses.

Alkali ions in glasses give rise to high losses and these losses increase as the number of ions present increases. Glasses containing a combination of alkalis show lower losses than the equivalent compositions with only one alkali. Divalent ions do not contribute as much to losses as alkalis but high power factors are shown by glasses with high BaO or PbO content. Using combinations of these oxides instead of only one, slight reductions in power factor are effected. Dissimilar interstitial ions interact in ultrahigh-frequency fields with the result that energy absorption is reduced. Thus the losses of high lead glasses are reduced by alkalis and, on the other hand, the presence of RO lowers the losses of glasses containing R_2O. Alumina increases the dielectric losses of glasses much in the same manner as other network modifiers.

3. Study of Factors of Technique in Glass Density Determinations by a Sink-Float Method. *By R. D. Duff: Owens-Illinois Glass Company, Streator, Ill.*

Procedures which have been in use for several years in a bottle plant for the purpose of making daily determinations of glass density as a check on glass composition are described. These procedures are reexamined experimentally with a view to adopting any changes in technique, as suggested by Knight and by others, which would yield results more quickly.

This study includes (1) a comparison of alternate methods of observing sink-float temperatures as to precision and time required, (2) the determination of the effect of handling and marking samples, (3) an estimate of the variability introduced into density results by the use of samples from commercially annealed bottles, (4) a comparison of the amount and type of information which may be expected from various plans of density-sampling plant production, and (5) data on the reliability for use in glass-composition control work of rod samples taken from forehearths, troughs, or tap streams.

The use of rod samples, prepared as described and without annealing, is recommended in composition control work for the following reasons: (1) Elapsed time between the time the batch enters the furnace and the completion of density determinations on the resulting glass is approximately 3 hours less than when lehr-annealed bottle samples are used and approximately 6 hours less than when reannealed bottle samples are used; (2) rod samples show less variability in the effect of thermal history on density than do samples from lehr-annealed bottles from a number of lehrs; and (3) rod samples are available regardless of whether finished ware is being produced.

4. Glassmelting in Laboratory Electric Furnaces. *By W. A. Hedden, L. Harrop, and W. W. Grigorieff: General Electric Company, Pittsfield, Mass.*

A general description is given of the construction and operation of small laboratory glassmelting furnaces. Data on chemical composition and on physical contents of a lead-borosilicate glass are presented and correlated with the operation of the furnaces.

5. Defects in Glass Caused by Working Conditions. *By W. F. Curtis: Fostoria Glass Company, Moundsville, W. Va.*

The purpose of this presentation is to form a background for a discussion by the Division on the problem of defective glass due to working conditions in hand plants. Some of the more common defects, such as cords, blisters, seeds, laps, wave, chill marks, crizzles, and smears are listed and some of the causes of these defects are discussed. Temperature of the glass, correct gathering punty, and improper handling tools are some of the things that enter into this picture. There is also the problem of inapt, untrained, and unskilled workmen, which was acute under wartime conditions, and is now a problem when manpower is still short.

Tuesday Afternoon, April 30, 2:00-5:00 P.M. Chinese Room

6. Silicones: New Silica-Based Plastics of Interest to the Ceramic Industry (*Jour. Amer. Ceram. Soc.* **29** [3] 66-70 (1946). *By Shailer L. Bass, J. F. Hyde, and R. R. McGregor: Corning Glass Works, Corning, N. Y., and Dow-Corning Corporation, Midland, Mich.*

Silicones derive many of their most useful properties from the inorganic nature of the silicon-to-oxygen links which they possess in common with glass and mineral silicates. They derive plasticity, solubility, and water repellency from the organic radicals attached to their basic structures. The chemical nature of silicon in combination with oxygen permits the development of a variety of silicone compounds in various physical forms ranging from fluids through gels and resins to elastic materials. Because of their ease of application, general heat stability, and chemical inertness, they are natural complements to ceramic bodies in many applications. They are already proving their usefulness with these materials in the production of new types of electrical insulation, in the surface treatment of glass and ceramic products, and as auxiliary dielectrics for use with ceramic insulating forms.

7. Insulation of Continuous Glass Tanks and Other Glass-making Equipment. *By W. Raymond Kerr: Armstrong Cork Company, 27th Street Plant, Beaver Falls, Pa.*

8. Notes on Silicate Analysis: I, Elimination of Excess Hydrofluoric Acid (*Jour. Amer. Ceram. Soc.* **29** [4] 114-15 (1946). *By B. B. Osthaus: Libbey-Owens-Ford Glass Company, 1701 E. Broadway, Toledo 5, Ohio.*

A procedure is outlined for using chemically prepared silicic acid for the removal of fluorine after decomposition by hydrofluoric acid and prior to analysis of insoluble silicates. (*Note:* This paper will be read by title only.)

Wednesday Forenoon, May 1, 9:00 A.M.-12:00 M. Chinese Room

9. Oxidation-Reduction Phenomena in Glass. *By Alfred W. Bastress: Glass Science, Incorporated, State College, Pa.*

(*Continued on page* 212)

DIELECTRIC MELTING OF GLASS IN FRANCE

In a recent issue of *Bulletin de la Societé francaise des électriciens, sér.* 6, 5, 70 (1945) M. Descarsin reports on the work performed in France during the war on the applications of dielectric heating in glass manufacture.

There are three main types of heating by electricity in which the heat is produced in the glass itself (this condition eliminates heating coils which give energy to glass by convection, conduction and radiation). The first is heating by Joule's law. The glass is placed between two electrodes and serves as the conducting medium between them. At a given applied voltage the heat evolved in a unit time is inversely proportional to the resistivity of the glass. Since this resistivity is enormously high at low temperatures, this kind of heating cannot start at room temperature, and the glass has first to be heated by another source, for instance, by an oil or gas flame. That is one of the drawbacks of Joule's heating. Another is the necessity of having the electrodes in contact with the glass. Molten glass assisted by electric current corrodes almost any electrode, and the corrosion products contaminate the glass. This method is used by La Société Electroverre in Romont, Switzerland, and by Compagnie de Saint-Gobain in Italy; their furnaces are capable of producing 12 tons of glass per day.

The second kind of electric furnace uses high-frequency heating. It is more suitable for metals than for glass since the frequencies giving a high utilization of energy are the higher the greater is the resistivity of the medium. Since the resistivity of glasses at low temperatures is so great, the high-frequency heating cannot start from room temperature and requires a pre-heating. But even at 1000°C (1832°F) the conductivity of ordinary glasses is so low that frequencies over 10^8 cycles per second are necessary for an efficient heating. These frequencies are still too expensive for a large scale commercial application.

Dielectric heating is specially suited for substances of a low electric conductivity. It is widely used, e.g., in vulcanization of rubber, in drying of wood, etc. However, these applications all involve relatively low temperatures, and Descarsin claims to be the first to extend the method to very high temperatures. In electric current heat is produced by friction of ions against the medium in which they move. In dielectric heating the friction takes place between rotating dipoles and their medium.

The equation governing this third kind of electrical heating is

$$W = \frac{V^2 C \omega \tan \delta}{1 + \tan \delta}$$

W is the heat evolved per second, V the voltage applied, and ω the frequency of the current. The letter C and δ need a more detailed explanation. Two electrodes with a piece of glass between them form an electric condenser. C is the capacity of this condenser at very low frequencies. At high frequencies charging and discharging of this condenser consume more electricity than would be expected in an ideal condenser as described in electrostatics. The power loss δ is a measure of this excess. The capacity C depends on the dielectric constant of glass and increases with it. Since the dielectric constant of ordinary glasses rises with temperature, the capacity C as well increases with the latter. However, this increase is much less pronounced and much less important than that of δ. The value of δ rises, e.g., from 10 seconds of a degree at 160°C (320°F) to 300 at 360°C (680°F). As the above equation shows, the evolution of heat increases with δ until δ becomes greater than 45°. This angle of loss seems to be reached only at temperatures above those encountered in glass making, and generally W is the greater the higher the temperature. Soda-lime glasses have a higher δ and consequently a higher W than have borosilicates. Usually δ is the greater the greater the electric conductivity of the glass.

Dielectric heating has been used so far only for glass melting in pots, not for any continuous production. The pot is placed between two metal electrodes cooled with water. To the electrodes a voltage of 4,000-12,000 volts is applied; the wave length of the high frequency alternating current is 15 to 60 meters, and the wattage may reach 60 kw.

The pots used contained up to 100 kg. of batch. The material of the pots is very important since all the refractories are silicates as is glass, and their angle of loss is not very different from those of glasses. The pot becomes hot together with its charge, and no perfect material for it has yet been found. The pot is slowly rotated about an axis parallel to the faces of the electrodes. This is necessary to avoid local overheating. As stated, the evolution of heat rises with temperature. This means that if a portion of the pot or the batch casually becomes hotter than its neighborhood, more heat is produced in it than in the neighboring mass, and the temperature difference continues to increase. When in preliminary experiments the pot was not rotated, it was soon pierced in the places of the highest field intensity.

The composition of the batches used is not given in the original paper. It contains a heating curve of a batch, one of the components of which was sodium sulfate. When electric field was applied to this batch, the temperature rose immediately, and the current (and the heat W evolved) also rose. This took a few minutes. After this time the temperature reached 100°C (212°F), the major part of water originally present in the batch had evaporated, and the curent dropped again. Still, it was strong enough to raise the temperature further. This second stage lasted about 15 min. and ended when the temperature reached 250°C (482°F). A transformation of sodium sulfate takes place near this temperature. In the third stage the temperature increased further and the current rose with it, in agreement with the above mentioned temperature effect on the angle of loss δ. 150 minutes after the start of heating the temperature was 1250°C (2282°F). 6 hours after the start of heating it was 1400°C (2552°F). Then the voltage was lowered

(*Continued on page* 214)

GLASS CONTAINER SHORTAGE IN GREAT BRITAIN IS CRITICAL

Some Glass Packers Operating Only Three Days a Week. Several Manufacturers Carry on Advertising Campaign for Return of Used Containers.

By TOM C. SUTCLIFFE
J. W. Sutcliffe & Co., London, England

While the glass container situation in Great Britain has been difficult for quite some time, current reports indicate that the position of the industry today has developed into an extremely serious one.

There are several reasons for this: one partly being the shortage of labor and, in this connection, the President of the Board of Trade was asked in the House of Commons on January 28 this year, "If he is aware of the shortage of medicine bottles in the chemists' shops at Macclesfield; and will he arrange for manufacturers to give priority to their manufacture". To which the President replied, "There is a general shortage of glass bottles owing to lack of sufficient labor in the industry, which my Department is doing its best to increase. The glass manufacturers have been asked to give priority to supplies of bottles for a number of essential purposes, including medicine bottles. If the public would return to the chemists' any empty medicine bottles which they have, they would be of great assistance."

Apart from the labor situation, however, shortage of supplies in relation to demand has largely been due to several glass works being bombed by enemy action.

Another factor contributing to the glass container shortage is that hardly any glass works or their customers have been able to hold reserve stocks with the result that they have been running from hand to mouth. The shortage has become so acute that it is quite common to read appeals and advertisements in the daily press urging the public to return their empty bottles and, in some cases, notices with the same request are displayed in the stores.

Typical newspaper advertisements by bottlers and packers appearing in British papers urging the return of used containers.

Efforts have been made to collect used jars which have been sorted and washed, but this has proved to be a very difficult and disappointing proposition on account of the great variation in shape and capacity. It is worth noting that in some cases the cost of the second-hand jar to the user was approximately double the price of the new container.

In order to try and help everybody, it has more or less been the policy of the glass manufacturers to have short runs of bottles in an effort to serve on a quota basis as many users as possible. It can safely be said that in some trades bottlers and packers are getting only a sufficient quantity of glass containers to keep them going for about three days out of the week. Before the war, there was a certain amount of continental glass arriving in England, but this, of course, is no longer available.

During and after the last war, supplies of glassware were sent over from Canada and America and these, at the time, were far ahead in regard to quality and finish than had been experienced here before, which undoubtedly set a higher standard of quality with the users. Supplies of bottles from Canada and America have not been possible this time, of course, due to the shipping position, the rate of exchange and the huge demand for glass containers in the United States and Canada.

No doubt readers will be interested to learn that the prices of glassware have advanced only 30 per cent on pre-war prices.

Before the war the bulk of silica sand was imported from Belgium and Holland, but during the war, this has been obtained from our own sources at home with very little detriment to the appearance and strength.

The question of the standardization of shapes and sizes does not appear to be making much advance. There are some bulk lines, such as jam, beer and medical bottles, but most firms, apparently, still prefer their own private mold. In fact, in a good many cases, they would rather wait for their own designs sooner than adopt a standardized shape as a substitute.

THATCHER T-SQUARE CAMPAIGN INTENSIFIED

The Thatcher Manufacturing Company has enlarged its promotion and merchandising campaign for the T-Square glass milk bottle. Two of the additions and revisions to the merchandising program are the new T-Square advertising kit, a complete packaged unit containing promotion material for dairies converting to the new type T-Square, and three-foot wall and floor posters for the various sales offices and jobbers.

PROPOSED FIVE-YEAR OPTION IN GLASS ENGINEERING AND TECHNOLOGY AT OHIO STATE UNIVERSITY

A prospectus outlining the proposed course of study in glass has just been issued by the Department of Ceramics at Ohio State University. Announcement has previously been made that Dr. H. H. Blau, Vice-President of the Federal Glass Company, Columbus, Ohio, will be the professor in charge of the new department, devoting a part of his time to teaching. Dr. Blau's achievements in the field of Glass Technology are well known, and leave no doubt of his fitness for this position.

By requiring five years for the completion of the course, the department finds it possible to give more time to the field of specialization and also to find a total of 40 term hours (the term or quarter being approximately equivalent to two-thirds of a semester) for non-technical subjects, often designated as humanistic and social studies. These are designed to give the student glimpses of several fields of knowledge including economics, geography, psychology, political science, speech, law, and accounting, with a total of 14 term hours for non-technical electives.

The emphasis, in the technical courses, is definitely upon engineering. Physics as a specific study is not carried beyond the standard sophomore course, and Mathematics terminates with Calculus and its applications to Mechanics and Strength of Materials. A solid year of Physical Chemistry follows the Analytical Chemistry of the sophomore year, in which is specified Ceramic Analysis without particular reference to the analysis of glasses. The course is associated with Ceramic Engineering in such subjects as Winning, Preparation, and Forming Processes, Elements of Ceramic Plant Engineering, Structure and Equipment Design, Physical and Chemical Measurements of Clays, and Refractories and Their Uses. In addition to drafting which is presumably given in the standard freshman year, the fourth-year men have a course in technical drawing.

Specialization on glass is represented by 27 term hours. The division of time and the choice of subjects seem well chosen, although the prospectus does not mention specifically the subject of color and colored glasses. For one of these courses a new title, "Physical Vitreology" appears. This deals with fundamental concepts and relations of the glassy state, from modern viewpoints. It thereby departs from the more severely engineering point of view of most of the other glass courses, although a similar approach is evidently made in the introductory courses on glass.

In the fifth year outlined for students taking the M.Sc. degree, a total of 22 term hours are electives and the other subjects, with the exception of thesis and seminar, appear to be of undergraduate character.

The entire experiment, if such it may be called, of extending undergraduate work in the field of glass to five years, is one that will be watched by glass-company executives with a great deal of interest. It has the genuine advantage of broadening a man's training considerably by giving him more time for college subjects outside his field of specialization. However, it postpones his entrance into useful work by one more year at a time when the shortage of engineers and technologists, because of the enlistment of students in the armed forces, is one of our industrial problems.

An outline of the proposed catalogue descriptions of glass technology course follows: 6aa. General Glass Technology. Five credit hours, Autumn Quarter, Third Year. Three lectures, four hours laboratory. An introduction to commercial glasses from the viewpoints of their physical and chemical fundamentals. Starting with simple soda-lime glasses, the roles of the constituents are illustrated experimentally and considered in relation to: (a) The formation of glasses; (b) The physical properties of glasses; (c) Modern theories of the structure of glasses.

6ab. General Glass Technology (Advanced). Five credit hours. Winter Quarter, Third Year. Three lectures, four hours laboratory. Continuation of 6aa with particular emphasis on the coordination of composition and physical treatment for obtaining desired properties. This will include the detailed discussion and study of special types of glasses.

6ba. Glass Mixing, Melting and Furnaces. Three credit hours. Winter Quarter, Fourth Year. Three lectures. The practical processes and equipment for producing commercial molten glasses, including the selection and handling of materials, charging, processes in the furnace, types of furnaces, furnace design and operation.

6cb. Glass Manufacturing Processes. Four credit hours. Spring Quarter, Fourth Year. Four lectures. The industrial processes employed in the manufacture of various types of glass products, with special emphasis on the relations of physical properties to processes and products. This includes the study of hand production methods, the development of various machine processes employed in the manufacture of containers, bulbs, tubes, flat glass, wire glass, etc., as well as the annealing, heat treating and decoration of glass ware.

7ca. Physical Vitreology. Five credit hours. Autumn Quarter, Fifth Year. Three lectures, four hours laboratory. The theoretical coordination of the previous courses in glass technology through the review of the fundamental concepts and relations of the glassy state, including such viewpoints as random space net-works, bond energy relations, thermal history influences, X-ray diffraction studies, and phase equilibrium diagram relations to the glassy phase.

7cb. Glass Manufacturing Problems. Five credit hours. Spring Quarter, Fifth Year. Three lectures, four hours laboratory. The practical coordination of the preceding courses in glass technology through the study of glass plant problems, including the investigation and analysis of defects of commercial glassware, methods for minimizing defects and their relation to production control and product performance.

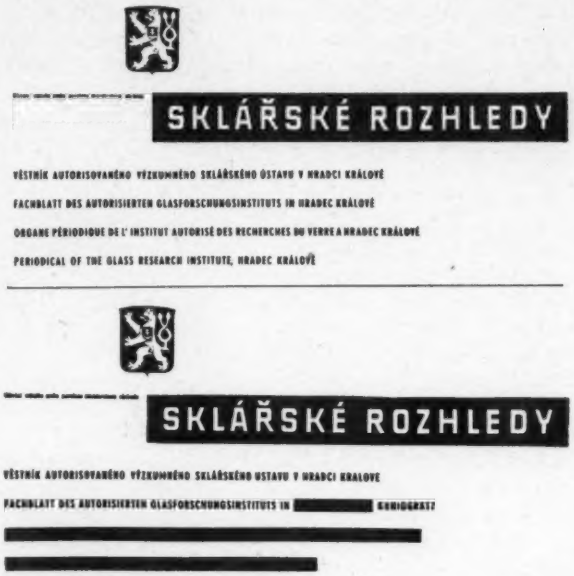
• The Brown Instrument Company division of Minneapolis-Honeywell Regulator Company has opened a sales and service office at 16 State Street, Rochester, New York.

THE GLASS INDUSTRIES IN CZECHOSLOVAKIA

According to information received in Washington through our foreign services, nearly all Czechoslovakian glass factories have survived the war without major damages. In the summer of 1945 conditions were somewhat obscured by the lack of reliable statistics after six years of occupation and the turmoil of liberation. Estimates of Czech manufacturers familiar with hollow glass stocks ready for exportation as of that time amount to about 12,000,000 crowns; that is nominally about one-half million dollars. Most of these goods are jewelry, spangles and cut glass. The capacity of sheet glass manufacture is unaltered and amounts to about 200 million square feet per year, of which 150 million will be available for exportation next year. The bulk of this production is window glass. There has remained intact the entire and rather considerable production in figured rolled glass, the full impact of which will be felt on the export markets.

The big export organization Kotva, a subsidiary of the famous Czech shoe factories of Mr. Bata, has confirmed these estimates after a thorough field investigation. Otherwise, industrial, scientific and personal news from the Czechoslovakian glass industry is very scarce, even in official circles, since the time of the blackout of Czech life in 1939 (see plate). The main activities of production have been stopped before and after the liberation not only because of labor and coal shortages, but also because of the shutdown forced on the big Czechoslovakian Solvay Soda plant in Nestomice.

One of our readers has received a letter from his former company, a major plant in the province of Morava. This plant had suffered terribly during the occupation. After the Germans had taken the village, nearly 20 per cent of the workmen were put into prison because of their union affiliation. When released, they could not receive a working permit for a long period. Finally, they were permitted to return to the plant under strict supervision and barely survived under the diet available. The German Government sold the seized plant to a competitor who removed the machinery and demoted the skilled glass blowers to performance of the simplest jobs. The had been responsible for the dictatorial direction of the future of the plant is uncertain. After the liberation, many foremen and office employees found themselves charged with collaboration with the enemy and those who plant fled while others are in custody. At this time, the plant appears to be run by a workers' committee.


SKLÁŘSKÉ ROZHLEDY

VĚSTNÍK AUTORISOVANÉHO VÝZKUMNÉHO SKLÁŘSKÉHO ÚSTAVU V HRADCI KRÁLOVÉ

FACHBLATT DES AUTORISIERTEN GLASFORSCHUNGSINSTITUTS IN HRADEC KRÁLOVÉ

ORGANE PÉRIODIQUE DE L' INSTITUT AUTORISÉ DES RECHERCHES DU VERRE A HRADEC KRÁLOVÉ

PERIODICAL OF THE GLASS RESEARCH INSTITUTE, HRADEC KRÁLOVÉ

SKLÁŘSKÉ ROZHLEDY

VĚSTNÍK AUTORISOVANÉHO VÝZKUMNÉHO SKLÁŘSKÉHO ÚSTAVU V HRADCI KRÁLOVÉ

FACHBLATT DES AUTORISIERTEN GLASFORSCHUNGSINSTITUTS IN [redacted] KÖNIGGRATZ

Under the German occupation, the journal of the Glass Research Institute in Czechoslovakia was changed. The illustrations show the blocking out of English and French sub-titles and the substitution of the German name, Konig-gratz, for the town of Hradec Kralove.

At least 10 larger glass plants will be categorized with the class of factories employing over 500 people which, according to newspaper reports, will be socialized against compensation. From trends observed under the function of the Manufacturer's Export Organization in 1939 it can be expected that a reorganization will take place with the tendency to specialize any single major plant on one line of manufacture or at least to a considerably smaller scope.

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300 ATTEND AGA CONFERENCE

Three hundred engineers, designers and technical experts from gas utility and gas appliance manufacturing companies attended the first postwar Technical Conference on Domestic Gas Research held in Cleveland in February.

The Conference program reviewed the most recent developments in domestic cooking, water heating, ventilation and space heating which have resulted from the domestic gas research projects now under way at the A.G.A. Testing Laboratories, Purdue Research Foundation, Battelle Memorial Institute and other institutions.

Engineers from the American Gas Association Laboratories presented papers on research projects. Papers were also read by scientists from Purdue, Battelle and Case schools.

Guest speakers at the first luncheon meeting were Everett J. Boothby, president of A.G.A., and Lyle C. Harvey, president of G.A.M.A.

CORNING ANNUAL REPORT

Sales volume of Corning Glass Works and subsidiaries declined $4,195,819 in the year ended December 31, 1945, as compared with the preceding twelve months, according to the company's annual report. However, because of income and expense items of a non-recurring nature and lower tax payments, the company's net income showed a gain of $392,255 for the year.

Manufacturing and sales capacity, the report disclosed, were increased in 1945 by the purchase of a plant at Leaside, Ontario, Canada, and the acquisition of a minority interest in the Cristalerias de Chile, leading glass manufacturer of the Republic of Chile.

INVENTIONS AND INVENTORS

A Summary of Recently Issued Patents of Interest to the Glass Industry

Feeding and Forming

Patent No. 2,396,254 shows a machine for drawing tubing having a very accurate internal diameter. This patent was assigned by the inventor, Samuel J. Everett, to James A. Jobling & Co., of Sunderland, England. The patent shows a tube drawing machine of the Danner type provided with a rotating internal former located at about the point where the tube becomes rigid.

Referring to Fig. 1, the molten glass flows from a tank 52 onto a refractory mandrel 53 from which a tube 50 is drawn in a manner similar to the well-known Danner machine. This mandrel is rotated at a speed of 4 to 10 rpm. by a worm and gear mechanism 62 and 63. Rollers 54 located 10 or 15 feet from the mandrel carry the tubing away.

The particular novelty of this invention consists of an internal former 55 which is rotated at a speed of about 70 rpm. by a flexible shaft 57 driven by a worm and gear 60 and 61. A metal tube 56 enclosed the flexible shaft throughout its length. Air pressure is maintained in the tube by a wind nozzle 64. It is recommended that the former be made of silica, stainless steel or an alloy known as "Inconell". By this method, tubing having a bore sufficiently accurate for use in hypodermic syringes may be produced. By former methods, the inside diameter of the tube varied as much as 7½ per cent over and under size.

In starting the apparatus into operation, the tube is first drawn without the former 55 in position. The former is then inserted through the mandrel 53 and the internal diameter of the tube thereafter becomes accurate to within 0.00001 of an inch. The inside of the tube as it passes over the former may be lubricated with powdered graphite or other material supplied to the air from the nozzle 64.

Glass Compositions

Patent No. 2,397,005 was assigned to Harshaw Chemical Company by the inventors, Messrs. Harbert and Morris. The invention relates to low fusing enamels suitable for application to glass, these enamels comprising borosilicate glazes containing rare earth fluorides.

It has been known that the use of fluorides of alkali metals produce certain desirable results, but they also lower the resistance to both alkali and acid. It is claimed that the best results are obtained by using certain rare earth oxides and rare earth fluorides.

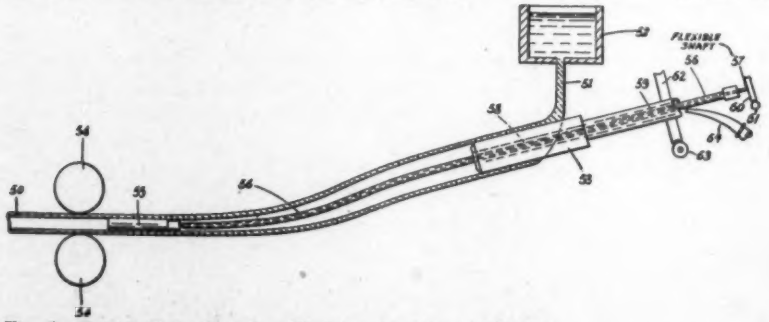


Fig. 1. British Tube Drawing Machine. Pat. No. 2,396,254.

The following table gives eight examples of the smelter batch composition and the theoretical melting composition. Much other valuable information can be obtained from this patent.

	Sample number							
	1	2	3	4	5	6	7	8
SMELTER BATCH (PARTS BY WEIGHT)								
Sodium silicate[1]	11.40	11.40	9.92	9.95	10.60	9.90	9.00	9.55
Titansil[2]	5.95	5.98	6.00	6.00	6.40	6.00	6.60	5.75
Lead borate	19.85	19.95	....	....	19.70	....	....	....
Lead monosilicate	38.27	38.40	52.65	52.70	38.10	52.50	54.00	50.60
Zinc oxide	.92	.92	.85	.90	.90	.90	1.50	.87
Cadmium hydrate	2.75	2.75	2.56	2.55	2.75	2.75	3.00	2.45
Silica	12.90	13.00	13.00	13.00	13.30	13.00	11.00	12.50
Barium carbonate	3.57	3.55	3.34	3.36	3.55	3.30	3.50	3.22
Boric acid	....	....	7.58	7.60	....	7.55	7.00	7.30
Zirconium dioxide	....	....	....	....	....	....	....	4.80
Neodymium carbonate	....	....	....	....	2.55	....	....	....
Neodymium fluoride	....	....	....	....	2.15	4.10	2.40	....
Rare earth oxide (cerium free)	....	....	....	.86	....	....	2.00	....
Rare earth fluoride (cerium free)	....	....	....	3.08	....	....	....	2.96
Didymium oxide	....	1.84	....	....	....	....	....	....
Didymium fluoride	....	2.21	....	....	....	....	....	....
Lanthanum fluoride	....	....	4.10	....	....	....	....	....
Thorium fluoride	4.39	....	....	....	....	....	....	....
THEORETICAL MELTED COMPOSITION (PARTS BY WEIGHT)								
Na_2O	4.25	4.28	4.18	4.18	4.24	4.18	4.02	3.92
BaO	2.82	2.82	2.75	2.74	2.66	2.74	2.88	2.64
PbO	49.00	49.30	47.40	47.60	49.30	47.30	48.55	45.60
ZnO	.94	.94	.90	1.05	.93	.95	1.57	.92
CdO	2.49	2.48	2.40	2.38	2.50	2.54	2.80	2.28
B_2O_3	4.68	4.68	4.53	4.50	4.70	4.52	4.20	4.35
SiO_2	29.40	29.40	31.50	31.40	29.50	31.40	29.10	30.25
TiO_2	1.92	1.94	2.03	2.00	2.15	2.02	2.23	1.95
ZrO_2	....	....	....	....	....	....	....	5.07
Nd_2O_3	....	....	....	....	1.91	....	....	....
NdF_3	....	....	....	....	2.21	4.35	2.53	....
Rare earth oxide	....	....	....	.90	....	....	2.12	....
Rare earth fluoride	....	....	....	3.25	....	....	....	3.12
Didymium oxide	....	1.90	....	....	....	....	....	....
Didymium fluoride	....	2.26	....	....	....	....	....	....
LaF_3	....	....	4.31	....	....	....	....	....
ThF_4	4.5	....	....	....	....	....	....	....

[1] Na_2O—25%; SiO_2—75%, by weight.
[2] TiO_2—32%; SiO_2—24%; Na_2O—25%; CO_2—19%, by weight.

Patent No. 2,396,585 is on a method of decolorizing glass produced by an electric furnace. This is the invention of Bernard Long of Paris, France, and the title is vested in the Alien Property Custodian. A license may be obtained under the usual terms.

Electrically melted glass has heretofore been characterized by a yellow or greenish-yellow tint. This color is caused by material coming from the electrodes. This patent proposes to correct the color of electrically melted glass by adding to the batch certain solvents, such as zinc oxide and cadmium oxide. Three examples

of this glass composition are given, the first of which appears below.

It is stated that glass produced by this mixture contains approximately 2 per cent ZnO.

Sand	100
Carbonate of soda	29.4
Sulphate of soda	2
Nitrate of soda	3
Limestone	26.8
Zinc oxide	2.7
Arsenious anhydride	0.5

Patent No. 2,396,873 was assigned to the Harshaw Chemical Company of Elyria, Ohio, by R. F. Morrison and William C. Morris. The patent relates to a borosilicate glass containing columbium and tantalum for use as a low fusing enamel for application to glass.

The result obtained by the teaching of this patent is a lead borosilicate glaze having a fusing temperature below 640° C. which is resistant to alkali. One example of this composition is given in Claim 6 of the patent, which is as follows:

A lead borosilicate glaze of low melting point suitable for application to glass and comprising a pigment and a melted glaze matrix, said matrix being on the analytical basis composed of the following oxides in approximately the proportions indicated:

PbO	parts by weight..	40 to 60
$Na_2O + Li_2O + K_2O$	do....	3 to 7
BaO	do....	0 to 6
SiO_2	do....	22 to 32
B_2O_3	do....	3 to 12
TiO_2	do....	0 to 5
A material of the class consisting of pentoxides of columbium and tantalum, and columbates and tantalates of barium, strontium, lead, calcium, zirconium, thorium, praesodymium, neodymium, lanthanum and mixtures thereof	per cent..	½ to 10

Patent No. 2,397,004 is an invention by Messrs. Harbert and Morris and was assigned to the Harshaw Chemical Company. The invention relates to a low fusing enamel of high alkali resistance particularly suitable for application to glass. It is said to be an improvement over certain prior U. S. patents No. 2,225,159, 2,278,868, and 2,312,788. The inventors have discovered that certain rare earths such as lanthanum, praesodymium, neodymium, and thorium yield oxides during the melting operation which improve the quality of the enamel.

The following table gives four examples of this composition which are considered satisfactory.

	Sample number			
	1	2	3	4
SMELTER BATCH (PARTS BY WEIGHT)				
Sodium silicate[1]	10.60	11.10	11.10	10.60
Titansil[2]	5.60	5.80	5.90	5.60
Lead borate	18.70	23.00	15.80	18.70
Lead monosilicate	36.10	33.30	42.00	36.10
Zinc oxide	0.90	1.00	1.00	0.90
Cadmium hydrate	2.70	3.00	2.70	2.70
Silica	15.00	16.50	14.30	15.00
Barium carbonate	3.70	0.20	0.18	3.70
Barium fluoride	2.70	2.10	2.12	2.70
Monazite residue (monazite less cerium and phosphate)	4.00	....	....	....
Didymium oxide	....	4.00	....	....
Neodymium carbonate	....	....	5.00	....
Lanthanum oxide	....	....	....	4.00

Patent No. 2,396,856 was assigned by the inventor, Burnham W. King, Jr. to the Harshaw Chemical Company of Elyria, Ohio. The patent relates to that class of enamels known as light ground coats and one coat white enamels. Numerous attempts have been made to provide a suitable white or light-colored enamel for use in one coat application.

Several examples are given of the composition by which improved results are obtained, 14 of which are tabulated as follows:

Sample number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
THEORETICAL MELTED COMPOSITION OF FRIT (PARTS BY WEIGHT)														
Na_2O	17.43	19.51	17.66	18.12	18.55	20.42	16.50	16.47	19.33	16.80	17.01	19.30	17.01	14.03
K_2O	2.14	....	2.28	2.34	2.41	....	2.16	....	2.21	2.18	2.20	....	2,20	3.94
B_2O_3	11.18	7.12	9.70	9.93	10.21	7.48	9.15	9.23	11.50	12.71	9.36	10.73	9.36	11.24
Al_2O_3	5.74	....	6.11	10.61	6.44	....	5.77	8.31	6.67	5.82	5.91	....	5.91	6.49
SiO_2	38.25	51.27	45.93	41.76	39.58	49.17	41.50	40.93	39.35	41.90	42.54	51.60	42.54	38.95
F_2*	11.90	9.36	9.11	9.45	9.60	9.83	10.49	10.59	10.50	8.68	8.81	4.29	8.81	5.24
CaO	4.96	0.74	0.04	0.04	0.81	3.47	2.82	2.80	0.04	0.73	0.74	3.22	0.74	7.79
CeO_2	8.40	10.99	10.77	7.07	11.34	9.63	8.45	10.26	10.40	10.25	10.40	10.73	10.40	11.95
P_2O_5	....	0.94	....	....	0.96	....	....	....	....	0.87	0.89	....	0.89	....
Li_2O	....	....	....	....	....	....	....	1.41	....	....	....	....	....	....
ZnO	....	....	....	....	....	....	....	....	....	....	2.08	....	....	....
MgO	....	....	....	....	....	....	....	....	....	....	....	....	2.08	....
BaO	....	....	....	....	....	....	3.16	....	....	....	....	....	....	....
Sb_2O_3	....	....	0.27	0.55	....	....	....	....	....	....	....	....	....	0.30
MoO_3	....	0.07	0.13	0.13	0.07	....	....	....	....	0.06	0.06	0.13	0.06	0.07
PER CENT REFLECTANCE (MgO = 100%) AT 40 GMS./SQ. FT. DIRECT ON STEEL														
Reflectance	56.7	55.0	68.5	61.5	70.0	44.0	53.0	60.0	65.0	64.7	70.0	55.0	69.6	56.5
PER CENT ADHERENCE AT 40 GMS./SQ. FT. DIRECT ON STEEL														
Adherence	80	70	95	80	70	70	80	60	50	75	70	90	50	50
SURFACE QUALITY AT 40 GMS./SQ. FT. DIRECT ON STEEL														
Surface	Good	Good	Good	Good	Good	Good	Good	Good	Poor	Good	Good	Fair	Good	Good

*Fluorine content of fluorine compounds in the smelter batch are calculated to fluorine although it is not certain in what state of combination the fluorine exists in the frit. The amount of oxygen indicated is excessive since all fluorides were calculated to oxides on the basis of determinations of the other elements.

Miscellaneous Processes

Patent No. 2,395,727 is a glass bending device invented by Manson L. Devol and assigned to Pittsburgh Plate Glass Company. It has been customary to bend sheet glass by heating it enough to settle over a forming mold shaped in a bed of sand. The surface thus produced was not always satisfactory and it was necessary to reshape the mold after each use.

Another method was to shape the sheet between metal molds. The objection to this was that many times the glass would stick to the mold. This patent overcomes these difficulties by providing a mold having a porous glass-engaging surface through which gas under pressure is passed through forming a gaseous film between the glass and the mold.

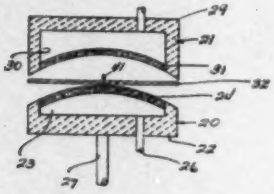


Fig. 2. Pittsburgh Plate Glass Bending Apparatus. Pat. No. 2,395,727.

As shown in Fig. 2, the molds comprise two boxes 20 and 21 having the open sides closed by porous mold surfaces 24 and 31. These surfaces are preferably made from sintered powdered metals or carborundum, graphite, silica, etc. Nitrogen under low pressure is admitted to the two boxes through pipes 26. When the lower mold is raised by the piston rod 27, the hot sheet 32 will be bent to conform to the shape of the molds, but direct contact between the mold material and the glass will be prevented by a thin film of gas perhaps 1/32 of an inch thick. This keeps the molds cool and gives a good surface to the bent glass.

Patent No. 2,396,728 was assigned to Johnson & Johnson of New Brunswick, New Jersey, by the inventor, Ralph L. Wells. This invention relates to the sealing and testing of glass ampoules which ordinarily contain a liquid and are often used for surgical sutures. A machine which has been previously employed for sealing such ampoules is shown in Patent No. 2,258,408 to Frank Cozzoli. Difficulty has been encountered due to the fact that variation in the wall thickness of the ampoule sometimes caused thin spots which demanded careful inspection and frequent rejection.

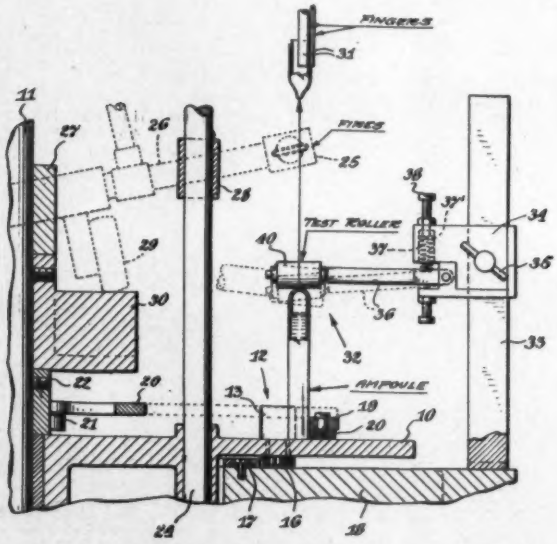


Fig. 3. Patent No. 2,396,728. Method of Sealing and Testing Ampoules.

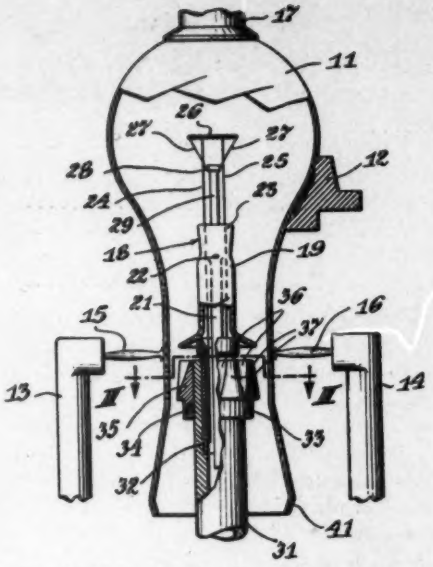


Fig. 4. Westinghouse Sealing-in Machine for Bulbs.

The present invention comprises a turret carrying a series of ampoules to be sealed. These are subjected to a flame for the sealing operation and thereafter to a testing mechanism which exerts sufficient pressure on each ampoule so that one in which the seal is too thin will break and the operator will be notified.

As shown in Fig. 3, each ampoule after sealing passes below a roller 40 carried on the end of an arm 36. This roller is forced downwardly against the ampoule by a spring 37, the force of which may be adjusted by a bolt 38. If the seal is of the necessary strength it will not break, but if the seal is thin, fracture will occur and the broken ampoule will be removed by the operator.

Patent No. 2,396,801 was assigned by the inventor, Louis D. Morand, to Westinghouse Electric Corporation. This patent relates to sealing-in glass bulbs used in incandescent electric lamps and similar devices. Difficulty has been encountered in sealing-in the mounts or flare tubes of electric lamp bulbs due to a variation in thickness of the glass. In the burn-off operation this often resulted in the formation of lumps, beads, or strings of glass, which made necessary a hand operation to remove the cullet.

As shown in Fig. 4, this invention provides a device by which a series of holes are provided where the burn-off takes place, thus insuring a clean cut-off and a uniform seal. This is accomplished by the use of a frusto-conical member 35 which is provided with a series of flutes 36 which increase in area upwardly so that when the gas fires 15 and 16 are directed against the lower part of the bulb a series of holes are formed opposite the flutes. The machine for carrying out this operation may be similar to that shown in Patent No. 2,212,842 to McGowan, dated August 27, 1940. During this burn-off operation the neck of the bulb is welded onto the flare in much more uniform operation than has heretofore been possible.

GJ Research Digest

Practical Interpretations of Glass Technology

Resistance of Plate Glass to Alkaline Solutions

The increased use of polished plate glass plates in contact with corrosive fluids has made the consideration of the chemical durability of this material of special interest. Tarnopol and Junge have investigated this subject and record their results in the February 1946 issue of the *Journal of the American Ceramic Society*.

It is generally known that glass is highly resistant to the common inorganic acids excepting, of course, hydrofluoric. The actual rate of penetration by the common inorganic acids would be perhaps 1/16 inch in 100 years, or 15 microns per year if held at 150°F., it was pointed out. The attack of the more corrosive alkaline solutions is somewhat faster at this temperature, ranging up to about 850 microns or 0.85 mm. per year for 5 per cent sodium carbonate, and higher at higher temperatures and concentrations.

However, the authors concluded from careful tests that plate glass can adequately withstand most alkaline solution up to 150°F., and some alkaline solutions at much higher temperatures where staining is not an important factor. Their investigation showed also that scale had little effect on corrosive rates and that the appearance of the glass gives no indication of the amount of corrosion.

Test specimens were cut from plate glass manufactured by the continuous flow tank process. Their approximate composition is 72% SiO_2, 14% Na_2O, 11.5% CaO and 2.5% MgO. They were immersed in solutions of sodium carbonate, sodium pyrophosphate, sodium hydroxide, potassium carbonate and potassium hydroxide, and results obtained by determination loss of weight at 5-day intervals up to 20 days.

At 150°F., concentration of 5 per cent alkaline solutions produced maximum rates of penetration (Fig. 1). At 180°F., however, the rate of penetration by sodium carbonate reached a maximum of about 3.4 mm. per year at a concentration of 11 to 12 per cent. Increasing the concentration above 10 per cent of the other materials did not alter the penetration rates appreciably. In general, the rate of reaction appeared to approximate the old rule of thumb, namely, "The rate of reaction doubles for each 18°F. increase in temperature". Potassium compounds acted slower than sodium salts, and sodium hydroxide slower than sodium carbonate and sodium pyrophosphate for this type of glass, the authors found.

Graphical data were presented to show penetration and penetration rates of 5 per cent alkaline solutions at 150°F., a comparison of sodium hydroxide and sodium carbonate penetration at three temperatures, the effects of alkaline concentrations up to 20 per cent on penetration rates and the effect of temperatures up to 210°F., on penetration by 30 per cent sodium hydroxide.

The Behavior of Laminated and Toughened Glass Under Impact by a Falling Ball

During a discussion of a paper by R. N. Haward on the behavior of laminated and toughened glass under impact at different velocities (*Journal of the Society of Glass Technology*, June, 1944), the question was raised as to the relation between the radius of the impacting body to the ascertained strength of the glass. It was suggested that the type of fracture obtained was a complex function of the impact energy, the radius of curvature, velocity of impacting body, as well as the dimensions of the glass specimen.

These points could be settled by experiment and Haward reports his results in the June, 1945, issue of the *Journal of the Society of Glass Technology*. It was concluded that experiments made with surfaces of constant curvature are therefore favorable to the explanation in

(*Continued on page* 206)

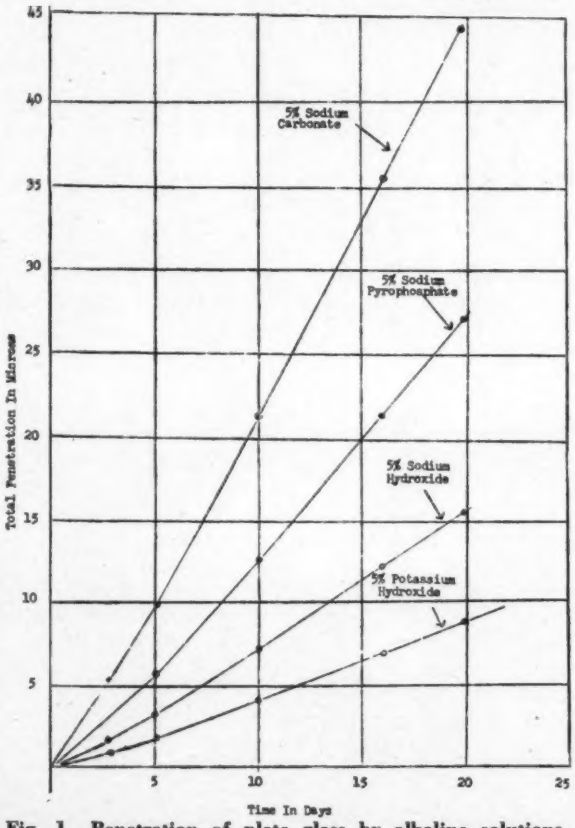
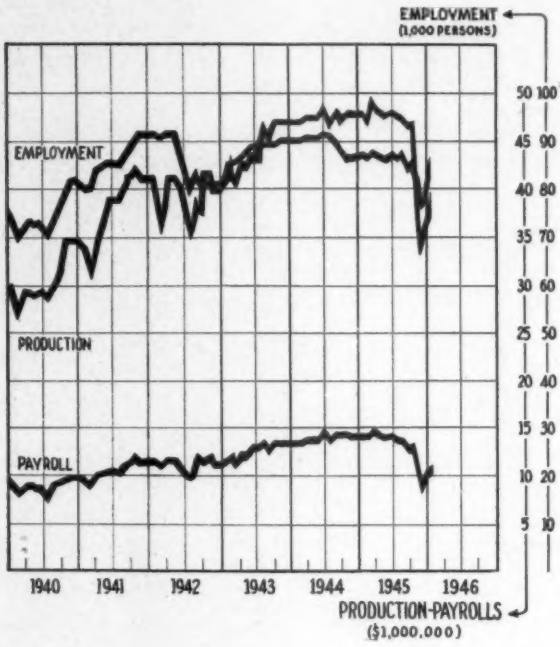


Fig. 1. Penetration of plate glass by alkaline solutions at 150°F.

CURRENT STATISTICAL POSITION OF GLASS

THE GLASS INDUSTRY'S INDEX



Activity in the glass industry for January 1946, as indicated by the Production Index, rose a little more than 5 per cent to approximately $39,000,500. December 1945 was reported to be about $37,200,500, and January 1945 was estimated at $48,000,000, which is about 18 per cent over January of this year. Output for the first two months of 1946 is about $76,200,000.

Employment and payrolls: During January 1946, 87,300 persons were employed in the glass industry. This represents an approximate 10 per cent increase over the 78,800 employees reported in December 1945. The January 1946 figure is slightly under the 88,000 persons employed during January 1945.

Payrolls for January 1946 rose about 5 per cent to an estimated $10,600,500. December 1945, according to the Index, was $10,150,000, and January 1945 was estimated to be $14,500,000.

Glass container production for the month of February 1946, based on figures released by the Bureau of Census, was 8,986,852 gross, which indicates an approximate decrease of 8 per cent from the 9,844,267 gross produced in January. Production for February 1945 was reported to be 7,495,253 gross, which is about 18 per cent under February this year.

Shipments during February 1946 dropped slightly to 9,032,312 gross. This drop was from 9,766,848 gross for January. February 1945 shipments were about 20 per cent under February 1946, or 7,495,253 gross.

Inventories on glass containers for February 1946 were 4,293,485 gross, as compared with 4,326,485 gross on hand at the end of January. Stocks on hand at the end of February 1945 were 5,358,571 gross.

It should be noted that two manufacturers were unable to report their figures in time for inclusion in the above compilation. Based on past records, these figures were estimated and industry totals adjusted accordingly.

Plate glass production for February 1946, according to the Hughes Statistical Bureau, was 13,849,437 sq. ft., as compared with 4,355,291 sq. ft. produced the preceding month. Production during February 1945 was 7,363,152 sq. ft. The total production for the first two months of 1946 is 18,204,728 sq. ft. as compared with

(*Continued on page* 194)

GLASS CONTAINER PRODUCTION AND INVENTORY

(All figures in gross)

		Production Feb., 1946	*Stocks Feb.*, 1946
Foods; Medicinal & Health Supplies; Chemicals, Household, Industrials; Toiletries & Cosmetics	Narrow Neck	2,769,598	1,795,862
	Wide Mouth ...	3,247,489	1,106,354
Dairy Products		314,451	161,652
Home Canning		128,219	419,033
Beverages, Returnable		422,613	378,319
Beverages, Non-returnable			
Beer, Returnable		712,718	80,341
Beer, Non-returnable		143,353	23,185
Liquors		895,594	223,806
Wines		261,197	83,517
Packers' Tumblers		91,620	21,832
Total		8,986,852	4,293,901

GLASS CONTAINER SHIPMENTS

(All figures in gross)

Narrow Neck Containers	*Feb.*, 1946
Foods	612,041
Medicinal & Health Supplies	1,141,173
Chemical, Household, Industrials	540,482
Beverages, Returnable	399,427
Beverages, Non-returnable	
Beer, Returnable	660,041
Beer, Non-returnable	141,062
Liquors	904,327
Wines	248,024
Toiletries & Cosmetics	481,928
Sub-Total (Narrow)	5,128,505
Wide Mouth Containers	
Foods	2,688,752
Dairy Products	317,365
Home Canning	67,329
Medicinal & Health Supplies	288,264
Chemical, Household, Industrials	125,558
Toiletries & Cosmetics	140,938
Packers' Tumblers	86,718
Sub-Total (Wide)	3,714,924
Total Domestic	8,843,429
Export Shipments	188,883
Total Shipments	9,032,312

IMPORTANCE OF GAS IN GLASS MAKING POINTED OUT TO FEDERAL POWER COMMISSION

The Federal Power Commission has been holding hearings since last October in connection with its investigation concerning the production, conservation, transportation and use of natural gas. At the present time the hearings are being held to receive testimony from the larger users of natural gas and to determine how essential natural gas is to industry.

Of interest to the glass industry is the testimony of Mr. John C. Schwab, Assistant Glass Factories Manager of Ball Brothers Company, Muncie, Indiana. At a recent hearing in Chicago Mr. Schwab stated that his company melted about 1000 tons of glass a day, and in answer to a direct question to describe in his own words the plant operation he said:

"In our glass plants gas is used for several purposes. The major portion of gas is used for actually melting the batch and making our glass. About 20 per cent of the gas used in the glass division is used for processes that we call our processing, that is conditioning of the glass for forge, and annealing the glass after it is made.

"The glass furnaces are fired in Muncie with natural gas. The batch is added to the back of the furnace. It is subjected to a temperature of approximately 2700 to 2900 degrees. It passes from the melting end of the furnace to the refining end or conditioning chamber where it drops to approximately 2300 degrees.

"From the refining chamber it is fed to each individual machine through a forehearth or feeder. The purpose of that forehearth or feeder is to condition the glass so far as temperature and homogeneity of temperature, uniformity of temperature to that particular temperature required to make the item on the individual machine.

"In other words, on any given furnace we might be making items from fractional ounce capacity up to as high as one gallon capacity.

"The size and weight of the container is controlled almost wholly with the temperature of glass and the weight of glass strudded from an orifice, in direct control and directly related to temperature.

"On our glass machines we use some gas for heating various parts of the equipment.

"From the machine the container is placed on a conveyor and conveyed to a lower or an annealing oven. During this conveying process it is necessary to heat certain sections in portions of that conveyor to eliminate defects such as checks which result from glass hitting cold objects.

"The finished containers are placed in annealing ovens and the temperature again is raised to about 960 to 970 degrees and is gradually cooled as the containers pass through the annealing ovens to room temperature where they are selected and packed."

Mr. Schwab continued: "From my description I think it is quite obvious that the making or breaking point of our whole process is one of heat control. The heat cycle must be controlled from melting to refining clear down to the annealing stage.

"Natural gas provides the most effective means of controlling that temperature. The use of other fuels can be applied to melting, but in a very minor degree are fuels other than the gaseous fuels used in the forehearths and in the annealing process.

"It is important that the fuel used in the glass plant is priced in order to enable our position to be competitive. As fuel in the manufacturing of glass containers is a very vital factor in costs that previous point is important.

"The Ball Brothers Company originally was founded in New York State some fifty-odd years ago and moved to Muncie, Indiana for the sole purpose and reason that natural gas was available.

"The Eastern Indiana area has quite a few glass plants probably for the same reason—that in the early days when natural gas was available it was an attraction to glass plants in that area.

"Today the use and need of natural gas for accurate temperature control is still that important."

After a few more questions which brought out the information that the Ball Brothers Company plant at Muncie used about ten million cubic feet of natural gas per day, testimony followed relative to the importance of natural gas in other operations that are conducted at this plant particularly in their processing of zinc —for melting and annealing. All in all Mr. Schwab stated a very clear case for gas, and it is hoped that the Commission will give due consideration to the gas needs of industry in the years to come.

BALL BROTHERS TRAINING PROGRAM

Training of a small group of employees in the over-all operations of glass container manufacturing was started by the management of Ball Brothers Company during 1945.

Men selected for training are assigned for specific periods to the various departments engaged in materials handling, production, quality control, shipping and warehousing and general office practices.

The program covers twenty-four months divided into fourteen sections of specialized training. As the trainee is assigned to a department, he is furnished with an outline questionnaire covering the functions of such department. Regular reports and examinations are required as a part of the program to determine the trainee's progress.

Upon completion of the training course, the successful candidates will be assigned to regular jobs as replacements are needed in the organization.

NEW APPOINTMENTS AT COLUMBIA CHEMICAL

The Columbia Chemical Division of the Pittsburgh Plate Glass Company has announced the appointment of William F. Newton as manager of market research and development.

Mr. Newton joined the company's research staff in 1941 and was made division superintendent in charge of synthetic resins and related organic products two years later. Prior to his joining Columbia Chemical Division, Mr. Newton was employed by the Shell Chemical Company.

At the same time, the company announced the return of J. Calvin Lee to its staff. Mr. Lee will represent the company in the Cincinnati area.

As Captain Lee in the Army, he was awarded the Silver and Bronze Stars and the Order of the Purple Heart. Prior to his commissioning in the Army, he was associated with the Columbia Chemical Division for four years.

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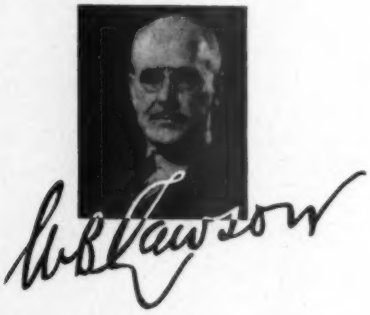


Merchants, Manufacturers' Sales Agents, Industrial Chemicals and Nonferrous Metals, Warehouse stocks in New York, Cleveland, St. Louis and Detroit.

Distributors for American Potash & Chemical Corp. (Borax and Boric Acid); Darling & Co. (Oleic and Stearic Acids); Duquesne Smelting Corp. (Nonferrous Metals, Zinc Dust); Ferro Drier & Chemical Co. (Driers and Metallic Soaps); Lindsay Light & Chemical Co.; Merck & Co. (Laboratory Reagent Chemicals); Philadelphia Quartz Co. (Silicates); Stauffer Chemical Co. (Sulphur); Tennessee Corp.; Virginia-Carolina Chemical Co.; Wyandotte Chemicals Corp.; and others.

CURRENT STATISTICAL POSITION OF GLASS . . .

(*Continued from page* 192)

16,278,085 sq. ft. produced during the corresponding period last year.

Automatic tumbler production for the month of February 1946 totalled 6,465,397 dozens, which is an approximate 12 per cent increase over the 5,752,850 dozens produced in January. The February 1946 figure is also an approximate 84 per cent increase over the corresponding month in 1945, which has been reported at 3,512,190 dozens. Shipments during February 1946 were 6,137,939 dozens, which represents an approximate 11 per cent increase over the 5,515,571 dozens shipped in January. Shipments for February 1945 were 4,114,352 dozens, or 49 per cent under the same month this year. Inventories at the end of February 1946 were 4,879,432 dozens, as compared with 4,532,551 reported for February 1945.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware for February 1946 were reported to be 3,681,302 dozens, which is approximately 16 per cent less than the 4,401,963 dozens reported for January. February 1945 sales were about 47 per cent below February of this year, or 2,502,64 dozens. Total sales during the 12-month period ending February 1946 were 38,334,736 dozens.

L-O-F REPORTS EARNINGS AND PLANS FOR EXPANSION

Consolidated net income of Libbey-Owens-Ford Glass Company and subsidiary for 1945 was $3,165,948 after provision for federal taxes, depreciation and reserves, and was equivalent to $1.24 a share on the 2,554,296 shares outstanding, it was disclosed in the annual report to stockholders. This compares with net income of $7,350,018, equivalent to $2.88 a share, in 1944.

Practically all war contracts were cancelled soon after V-J Day, and reconversion to peacetime products was delayed because of strikes in the flat glass and other industries. Sales for the year aggregated $61,381,868, according to the report.

Mr. John D. Biggers, President, stated, "There are new and expanding uses of glass ahead. To prepare for this expansion, large capital investments in new facilities are required, together with adequate appropriations for continuing research."

At the close of 1945, the sum of $13,458,257 was appropriated from the plant improvement fund for allocation to current construction projects or those planned in the near future. Included in the expansion program are two new plants for the Plaskon Division in Toledo to cost about $5,000,000.

At Rossford, Ohio, a new plate glass tank, machine and lehr are being built. The technical building in East Toledo is being enlarged and at Ottawa, Illinois, improvements now under way include installation of four automotive Tuf-flex furnaces, a second autoclave, a new water treating system, storage tanks and the rebuilding of the boiler house. Plant improvements are also going ahead in Shreveport, Louisana. During 1945, the annual report stated that L-O-F spent $1,725,558 on plant improvement.

G.C.M.I. SCHEDULES ANNUAL MEETING

The Glass Container Manufacturers Institute has scheduled its first annual meeting to be held in Hershey, Pennsylvania, on May 13, 14 and 15.

Meetings on May 13 and 14 will be under the auspices of the Board of Trustees for the purpose of receiving semi-annual reports from the nine standing committees and making these available to the industry generally.

On May 15, the annual membership meeting will be held. This meeting will be open only to regular members of the Institute.

OPA SUSPENDS STEMWARE FROM PRICE CONTROL

Effective March 6, 1946, the OPA has issued Amendment 17 which *suspends* "stem and footed glassware" from price control. These articles are suspended "for an indefinite period of time except when it is otherwise specifically provided for by the administrator". If there are unwarranted price increases, OPA action can again place the ware under price control.

Amendment 17 *exempts* the following items from price control: Cocktail shakers; ice bowls and buckets; high lead content crystal glassware completely fashioned without the use of molds or rings; kitchenware items sold to consumers for 30¢ or less, to dealers for 20¢ or less, to jobbers for 15¢ or less; christmas tree ornaments; and certain artists' supplies.

A. P. GREEN ELECTED NEW PRESIDENT

On May 1, Lieutenant Commander Robert S. Green, now on terminal leave following Pacific fleet duty, will become president of the A. P. Green Fire Brick Company. He will succeed his father, Allen P. Green, founder of the company, who moves up to the post of Chairman of the Board.

With the election of Robert S. Green as president, the company has announced the creation of an Executive Committee of the Board of Directors composed of H. B. Plunkett, Lester J. Miller, A. D. Bond, Walter G. Staley and Allen P. Green, Jr.

OWENS-ILLINOIS APPOINTS L. G. PHILLIPPS

It has recently been announced by the Owens-Illinois Glass Company that Leonard G. Phillipps, recently returned from service in the Navy, has been appointed manager of the Closure Sales Division.

Since joining Owens-Illinois in 1934, Mr. Phillipps has held the position of assistant manager of the Closure and Plastic Sales Division. He joined the Navy in 1943.

PITTSBURGH CORNING RETIREMENT PLAN

Pittsburgh Corning Corporation has announced a new retirement plan for all employees who have completed five years service with the company. All other employees automatically will become members of the plan following the completion of five years service with the firm.

Retirement normally is effective when the employee reaches the age of 65, but he may retire any time after his 55th year and receive reduced benefits. The company will pay the entire cost of the retirement plan.

DR. AUGUSTIN PRENTISS JOINS H-E

Dr. Augustin M. Prentiss, who recently served as Director of Materiel of the Chemical Warfare Service, U. S. Army, with rank of Brigadier General, retires on April 1 and has been appointed director of research and development of Hartford-Empire Company, it was announced recently. Dr. Prentiss will assume his duties with the company on April 1.

Born in Charleston, S. C., in 1890. Dr. Prentiss received his education in that state and in Washington, D. C. He holds degrees in civil engineering, chemistry and law. Since 1913 he has held a commission in the U. S. Army, and at the age of thirty-two was the youngest officer ever graduated from the Army War College. He saw overseas service in World War I as Executive Officer of the Chemical Warfare Service.

For several months prior to his retirement from the Army, General Prentiss, as Director of Materiel, coordinated the research and development of new chemical weapons and munitions, as well as their production.

THATCHER INCREASES AMBER GLASS FACILITIES

In an effort to supply users in the midwest with amber glass, the Thatcher Manufacturing Company has converted one tank at its Streator, Illinois factory to enlarge its amber glass production.

This is the second amber tank now in operation for Thatcher. The other, started in August 1945, is at the Olean, New York, factory. While these new amber facilities have been made available by converting flint operations, flint glass container production has been maintained at a high level.

The company states that milk bottle production has actually been increased. For each of the first two months of this year, milk bottle production and shipments were greater than for any previous month in the history of the company.

PRODUCTION MANAGERS MEET IN NEW YORK

A three-day conference in April to provide approximately 1,500 production managers from all types of industry in the United States an opportunity to exchange information and experience on common problems was announced recently by the American Management Association.

The meeting will be held in New York City, April 22, 23 and 24 at the Hotel Pennsylvania and will be open to members and non-members of the Association.

Subjects of the sessions will include productivity standards and measurement, employee and management incentives, training, discipline, labor-management cooperation, administration of cost and policy controls, employee suggestion programs, material handling procedures, quality and quantity objectives for employees, foremen and executives.

NEW EQUIPMENT AND SUPPLIES

IMPROVED WET BELT SURFACER

An improved wet belt surfacer which surfaces, grinds and removes stock by means of an abrasive belt has been announced by the Porter-Cable Machine Company, Syracuse, New York.

The new model, referred to as BG-8 is equipped with a larger capacity re-

circulating tank for longer operational performance. The coolant, applied to work and belt with a spray nozzle, maintains the work in constantly cool condition and prevents weakening of the structure of certain kinds of materials, such as glass, ceramics, plastics, rubber and tempered metals.

The depth of the machine has been reduced to 48 inches and the work table measures 38 inches from the floor. The automatic feed table assures a tolerance accuracy of .0005 inches, controls the in-feed pressure and speed, reduces operator fatigue by substituting mechanical pressure for hand pressure and frees the operator during the operation to prepare for the next production cycle.

ELECTRIC-PROPELLED HAND TRACTOR

Automatic Transportation Company, a division of the Yale and Town Manufacturing Company, Chicago, Illinois, has announced the Transtractor, a new electric-propelled hand tractor. It combines the features of the electric hand truck and the conventional warehouse tractor.

The Transtractor will push or pull a 6,000-pound trailer load all day or up to 20,000 pounds intermittently. Finger-tip control enables one man to handle any size or type of load with facility. It is equipped with a heavy-duty bumper plate for push and a coupler is available for towing operations.

Equipped with front-wheel drive, the Transtractor is exceptionally maneuverable for close-quarter operation. Forward and reverse drive controls are push-button type operated from the guide handle. Two forward and two reverse speeds are controlled by the vertical angle of the guide handle. Drive brakes are applied by the return of the guide handle—which springs upward automatically when released—to upright position. Standard equipment includes a battery capable of eight to ten hours' operation and a portable cabinet plug-in charging unit is available.

NEW THERMOCOUPLE TUBE

The Sylvania Electric Products, Inc., Electronics Division, at Boston, Mass., has announced a tube with a hot junction of a thermocouple element centered on a filament heater and designed to measure gas pressure through variations in thermal conductivity of the gas. Used with a microammeter, it will record pressure of 10^{-1} to 10^{-5} millimeters with plus or minus 5 per cent accuracy.

Applications include laboratory use as a pressure gage and leak detector in evacuating apparatus.

Operated in a simple three volt battery and resistance circuit, the tube may be sealed directly into evacuation apparatus by means of tabulation provided on top of the bulb. Direct measurement may be made with a 0-250 microammeter which may be calibrated for each gas measured. Maximum accuracy is assured by shielding the equipment from sources of radiant heat and air currents.

NEW ADDITION TO LINE OF DUST COLLECTORS

The Aget-Detroit Company, 602 First National Building, Ann Arbor, Michigan, has added Model 421 Dustkop to its line of industrial dust collectors. The new dust collector features exceptional portability for a self-contained dust collector and requires no installation bther than the placing of the unit in position on the bench and plugging into the light circuit.

In addition to a motor-driven fan, cyclone separator and filter, this model incorporates a grinding wheel hood which is built as an integral part of the unit.

Because the unit is equipped with a self-clearing paddle wheel fan, it is claimed that dry grinding, buffing, polishing and similar work which produces great amounts of long stringy material, lint, bristles, etc. can be easily handled. A removable pan in the grinding wheel hood allows sludge from wet grinding operations to be emptied separately.

A baffle plate in the hood prevents smalll work from being drawn by the air suction into the fan and at the same time spreads the effective area of the suction.

NEW CARBOLOY-TIPPED TWIST DRILL

The Nelco Tool Company, Inc., 370 Hamilton Avenue, Brooklyn 31, New York, announces a Carboloy-tipped twist drill which, it is said, permits faster cutting of plastics, ceramics, cast iron and bronze. Unlike steel drills which dull rapidly when used on such abrasive substances, this product has an extremely long life. It is stated that efficiency is increased because Nelco grinds the drills to suit the material to be cut.

Properly ground Carboloy-tipped drills can be used on glass and other materials which are too hard for steel drills. A descriptive folder is available upon request.

NEW ELECTRIC IMMERSION HEATER

The American Instrument Company, Silver Spring, Maryland, announces a new automatic electric safety immersion heater for liquids. The heater can be installed in any container where safe, automatic heat is required for heating liquids.

Once installed and set for the desired working temperature, it will function accurately without further attention. The built-in safety control will limit the temperature rise of the heater and thus protect against overheating and burning out should the liquid level fall and expose the heating element to air.

These heaters are available with copper sheaths for heating water, or with steel sheaths for heating light oils, in wattage ratings of 250, 500, 750 and 1,000.

NEW TEN-TON INDUSTRIAL TRUCK

The Elwell-Parker Electric Company, Cleveland, Ohio, has released information on its ten-ton industrial truck which was developed during the war years.

The new trucks are driven by means of storage batteries and electric motors. The body of the truck is low and the operator has complete visibility of platform, load and surroundings. Overall length is 147 inches, width 45 inches. It is steered by means of all six of its wheels.

The truck can turn in aisles 71 inches wide and speed may be accelerated rapidly to 6 miles an hour, while the truck can come to a dead stop within a few feet. Electric drive and controls provide great flexibility.

BAILEY METER DEVELOPS OXYGEN RECORDER

Bailey Meter Company, 1050 Ivanhoe Road. Cleveland 10, Ohio, announces the introduction of a new automatic continuous analyzer for indicating and recording the oxygen content of a gaseous mixture. The instrument has been successfully applied to glass tanks, boiler furnaces, kilns, many types of metallurgical furnaces, chemical and petroleum processes, the company reports.

The instrument provides a graphic analysis almost instantly and is said to be responsive to changes of .05 per cent oxygen. Sustained accuracy is said to be within .25 per cent.

A continuous gas sample is mixed with a vaporized liquid fuel and burned on a catalyst-filament which reaches a temperature proportional to the oxygen content. The filament resistance is a function of temperature and a simple resistance bridge is connected to a null balance electronic recorder which may be calibrated in excess air, per cent oxygen or other desired terms.

NEW POWER FACTOR REGULATOR

Modern Control Equipment Company, 176 West Adams Street, Chicago, Illinois, has announced the Haug System Power Factor Regulator. Connected to the lines of commercial power users, it is said that it will raise the power factor by taking the magnetizing current off the line with a negligible cost in operation. By increasing the power factor, it will greatly reduce the monthly power bill and will increase low voltage to desired value where voltage was previously low due to poor power factor.

The regulator has no moving parts, is samll in size, can be installed in almost any desired location and requires no discharge coils or other safety devices. Connected apparatus will function smoothly, resulting in more uniform and efficient operation of all motors and machines. Reactors and transformers are of dry type construction.

CATALOGUES RECEIVED

Jessop Steel Company, Washington, Pa., has issued a booklet entitled "Jessop Steels Cast-to-Shape."

The booklet is well illustrated with "cast-to-shape" tool steels such as forming dies, rolls, cams, rim rolls, ring fies, etc. Information about annealing, hardening, patterns, tempering and applications is given for each "cast-to-shape" tool steel product.

Tables are provided for reference and list of the Jessop Steel Company offices is also included.

Graton & Knight Company, 356 Franklin Street, Worcester 4, Mass., has issued a new book on the selection of mechanical packings types, their application and the design of adjacent parts in hydraulic or pneumatic equipment. The primary purpose of the manual is to outline the basic principles which influence packings life and resultant machine performance.

Illustrations include over one hundred drawings of packings design and application and many photographs of installations, causes of packings failure and their remedies, etc. There are nearly fifty reference tables which are included to save time-consuming calculations.

The Cleveland Worm & Gear Company, 3277 East 80th Street, Cleveland 4, Ohio, has issued a bulletin describing the applications of worm gear speed reducers to various types of mixing and grinding equipment.

Entitled, "Clevelands in the Modern Production Flow," the bulletin contains photographic illustrations featuring installations of worm gear units on equipment by leading industries for the processing of their materials.

Specific mixing and grinding operations include crushing, screening, agitating and polishing. Each worm gear application is briefly discussed and each photograph is accompanied by a facsimile blueprint detailing the drive application shown.

Wickwire Spencer Steel Company, 500 Fifth Avenue, New York 18, New York, announces the publication of a new folder describing its decorative perforated metal.

The folder illustrates various designs produced by the company and features specifically the Lacecane pattern. A brief description accompanies each of the patterns contained in the folder.

Ingersoll-Rand Company, Phillipsburg, New Jersey, has issued a new 20-page, two-color catalogue covering the design, construction and engineering details of its Cameron single-stage general service pumps.

These pumps are suitable for a wide variety of services wherever liquids have to be handled. The bulletin illustrates typical installations, cross-section and interior views and presents the various types of drive available.

Considerable space is devoted to performance and dimension tabulations and the catalogue is rounded out with the steps in the solution of a typical pumping problem.

G. W. Klages & Son, Inc., Pittsburgh, Pa., is offering a new edition, No. 46, of their catalogue on glass beveling, grinding, cutting and conveying equipment.

Eighteen machines are illustrated, including a tungsten carbide shaping machine, to show the range of the firm's machine designing and manufacturing facilities for other lines. Standard glass-cutting tables are also mentioned in the new bulletin.

Fischer & Porter Company, Dept. 5-4, County Line Road, Hatboro, Pa., has recently published a new eight-page bulletin. Among the subjects included are details of the master enclosed rotameter for normal pressures and temperatures; the armored rotameter for high pressures and temperatures; meters for recording, controlling and totalizing rates of flow; meters for very low flows and for extremely large flows; laboratory rotameters and others.

The bulletin contains engineering recommendations for the types of rotameters and materials of construction to be used in measuring the flow rates of a great many difficult and corrosive fluids and gases. The company's beadguide tube which eliminates the use of float guide rods and other float stabilizing means is also discussed, in addition to the inclusion of a rotameter capacity guide.

Electric Indicator Company, Stamford, Conn., has issued a new two-color brochure referred to as Elinco Catalogue "FB."

The booklet describes in detail typical Elinco units in the "FB" frame, designed to allow both base and frame mounting. Also illustrated and described are permanent-magnet A.C. and D.C. generators, split-field D.C. motors, permanent-magnet D.C. motors, series and universal motors, and shunt-wound D.C. motors.

Construction and characteristics of all types are given and performance curves shown for the typical units selected. Standard dimensions and cutaway view are also shown.

Industrial Lining Engineers, Inc., Edgeworth, Pa., has issued a four-page, two-color bulletin explaining what its particular service is to industry.

The company does not manufacture linings, but rather specifys and assists in the application of the particular type of lining best suited to solve a given problem.

Contractors, as well as consultants, the company describes its facilities for handling such work and also gives a brief review of its research facilities.

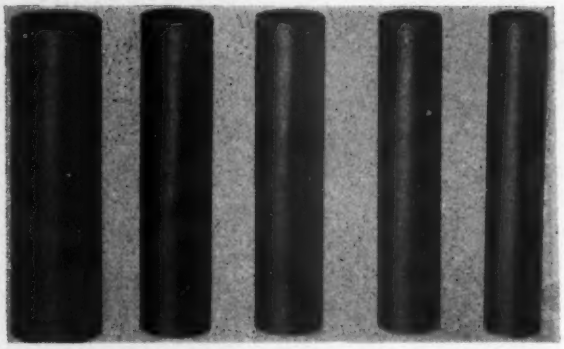
The B. F. Goodrich Company, Akron, Ohio, has issued a new broadside on its "Griptop" conveyor belt.

The folder illustrates the conveyor belt in action and explains its application to various operations.

The Wirebound Box Manufacturers Association, 43 East Ohio Street, Chicago 11, Illinois, has announced the issuance of a new minimum specifications manual. The manual, which is the result of a year's work by the Association's Design, Specification and Quality Committee, is designed to assure shippers of safe packing of their products and to help conserve the critical lumber supply.

Specifications have been drawn up for the packing of nearly every type of industrial container from light ceramics to 500 lb. engine blocks, and make a distinction between type of loads, their shape and other characteristics, as well as their total weight.

GUNITE
ROUND BAR STOCK



In actual glasshouse use round bar stock of Gunite has delivered highest performance for sleeves, plungers and similar castings.

Patterns are available in eighteen diameter sizes ranging from ¾" to 5", all bars are 14 inches long.

Gunite has proven to be of ideal hardness for glasshouse work. The metal can be machined with relative ease, yet retaining sufficient density to afford a brilliant polish.

There is a suitable Gunite Alloy for each type of glass making part such as Plungers, Guide Rings, Neck Ring Sticks, etc.

•

GUNITE
FOUNDRIES CORPORATION
ROCKFORD ILLINOIS
Established 1854

WYANDOTTE CHEMICALS RESEARCH DEPARTMENT HOLDS SEMINAR

The sixty-one technically trained staff members of the Wyandotte Chemicals Research Department recently held a three session seminar at the Detroit Book-Cadillac Hotel. One session was devoted to scientific activities within the department and one to corporation and management topics.

Technical papers presented by eight staff members of the department treated with problems prevalent in the several industries served by Wyandotte with their various compounds and organic and inorganic chemicals. These papers included a wide range of subjects including "Application to Physical Techniques to Chemical Research," "Synergism," "Current Trends in Chemical Patents" and "Synthesis and Evaluation of Mildewproofing Agents."

PERSONNEL DIRECTOR AT GAS CITY O-I PLANT RESIGNS

E. L. Flood, personnel director at the Gas City plant of the Owens-Illinois Glass Company, has resigned effective April 1.

Mr. Flood will be replaced by L. H. Nicolet, who has been in charge of personnel work at the concern's Clarion plant.

WICKWIRE SPENCER NAMES BUFFALO SUPERINTENDENT

The Wickwire Spencer Steel Company recently named G. Gordon Lloyd as general superintendent of the company's Buffalo plant, succeeding Alvin F. Franz who has been appointed Works Manager of the Pueblo Plant of the Colorado Fuel and Iron Corporation.

Mr. Lloyd, prior to his new assignment, has been general superintendent of the Clinton, Massachusetts, plant. He had been associated with the Carnegie Illinois Steel Corporation before joining Wickwire Spencer.

In his new position, Mr. Lloyd will be in charge of all production at Buffalo, including Wickwire Spencer open hearth, hot mills and wire departments.

H-E ENLARGES FACILITIES

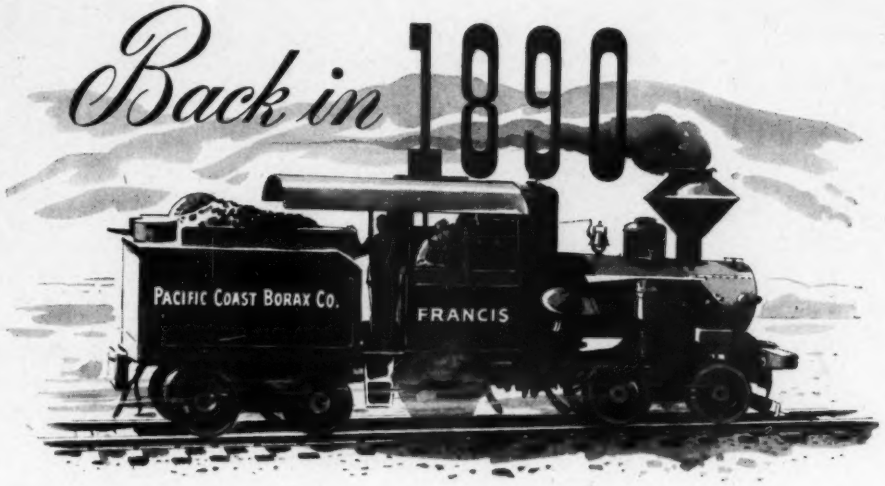
Shipping facilities of the Hartford-Empire Company will be more than quadrupled and employment increased by about one-third due to the company's recent purchase of a one-story building and two and one-half acres of land in Hartford, according to a recent announcement.

The new building will be used for processing, handling and shipping glass-making machinery. Space freed at the main plant, by consolidation of shipping facilities in the new acquisition, will be used for further increases in production capacity. The new Hartford-Empire plant brings to three the number of company-owned buildings and adds 54,000 square feet of space.

The company will employ 50 additional men at the new plant and about 100 more in the main plant.

• The Amsler-Morton Company will move to new quarter in the Chamber of Commerce Building on April 15. Pennsylvania Industrial Engineers is also moving its home offices to the new location. Both companies are divisions of Union Industries, Inc.

Back in 1890



Responding to the wheels of progress, the famous 20 Mule Teams were finally compelled to yield to the small gauge railroad and what was then known as a modern locomotive.

Here is a reproduction of an old photograph of the small but sturdy locomotive "Francis". The "Francis" did the work of the 20 Mule Teams for almost twenty years, from 1890 to 1907, hauling borate ore in small cars from the mine at Borate, California, to the calcining plant located at Daggett, situated in the Calico Mountains southwest of Death Valley. The big brother locomotives on the standard gauge Sante Fe Railroad took over from here and transported the borax to the outside world.

The new streamliners as we see them today, are a far cry from the toy size "Francis" with its old fashioned smoke stack, the inevitable whistle and clanging bell.

COLOR – Brilliancy and sparkle are synonymous with good color in finished glassware. There are various constituents which may be added to the batch in order to impart these desirable color characteristics. Batches containing B_2O_3 are more rapidly melted, require less decolorizer, and thus produce a glass of "good color".

Another good reason why Borax should be used as an essential ingredient in the batch formula.

Our representatives are prepared to discuss the special advantages of B_2O_3 in glass.

PACIFIC COAST BORAX COMPANY

51 MADISON AVENUE, NEW YORK 10, N. Y.

(*Continued from page* 181)

radial cracks would be apt to develop during drying along the lines of meeting of the slip.

Another type of crack would develop frequently in the corner of the pot approximately below the spout through which the slip flows first. This crack appeared only

Fig. 7. Casting the pot around the lining.

when the slip accumulated between the walls of the mold before the bottom was formed either because it was too thick or was permitted to flow more rapidly from the spout than it would flow across the base of the mold.

Vertical cracks occasionally occurred in the lining of the wall of the pot where the body slip from the different spouts joined. The use of a more fluid slip eliminated such cracks. Cracks starting at the rim during low humidity weather were eliminated by placing sacking around the rim during the first 10 days of drying.

The blade of a knife is used to separate any adhering lining from the core of the mold at the top inside edge of the rim of the pot about two hours after casting to prevent cracks from starting.

(b) Deflocculation and thixotropy of clays. The manner in which the clays reacted to deflocculants differed greatly[6]. There was also some difference in such reaction with the same clay but from different shipments. Also difficulties in deflocculation of the pot batch were encountered due to change in concentration of the silicate of soda caused by freezing or long storage. However, after the quantity of deflocculants had been adjusted for change in shipment of clay, no further adjustment was necessary as a rule until a change in clay again occurred. Changes in concentration of the solution of silicate of soda were eliminated by periodic agitation to prevent segregation of the constituents. Thixotropy[7] (Webster's unabridged dictionary defines thixotropy as the property or phenomenon exhibited by some gels of becoming fluid when agitated. The property is reversible.) was more pronounced in the ball clays than in the kaolins, the Kentucky No. 4 being more so than the Tennessee No. 5. The North Carolina kaolin exhibited this property much more than either the Georgia or Delaware.

4. *Burning or arching.* The pot is supported on a circular frame of four piers of silica shapes during burning. It is placed on the piers by means of a pot carriage, the tongs of which contain a spacer to prevent squeezing of the pot and possible rupture. The shapes measure 12 x 6 x 3 in. and the piers are built of three of these laid flatwise. The outside edge of the pot is flush with the outer edge of the pier; thus the wall of the pot is supported directly by the pier and sufficient of the bottom is supported to prevent sagging. If necessary to level the tops of the piers, a small amount of sand is used. Carelessness in setting an unfired pot in either the pot arch or the melting furnace may cause it to fail.

The burning schedule for the average pot is shown in Fig. 10. The pot arch does not cool below 75° or 80°C before it receives an unfired pot. The pot is heated to 1350°C in 49 hours and maintained at that temperature for 4 hours. The temperature is then permitted to drop

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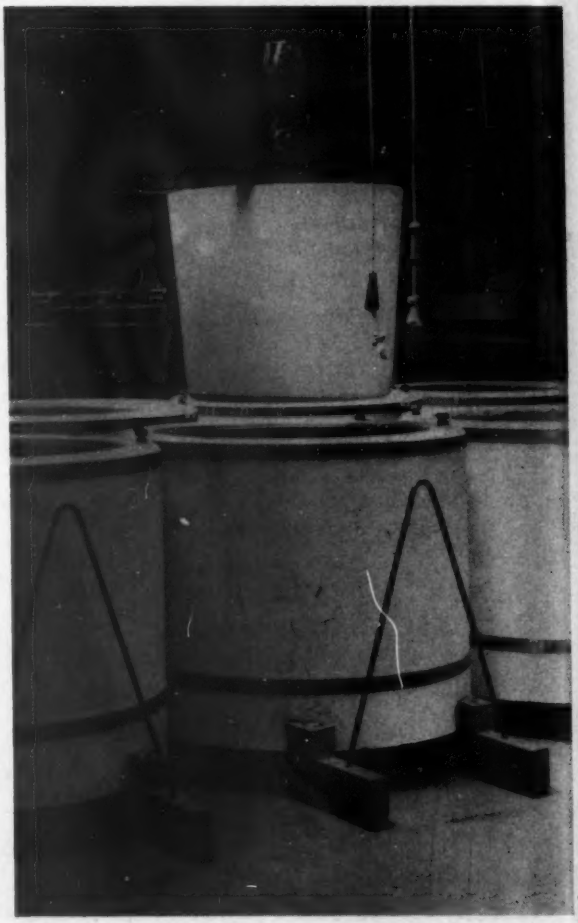


Fig. 8. Core is removed from pot 8 hours after casting.

FOR COLORS

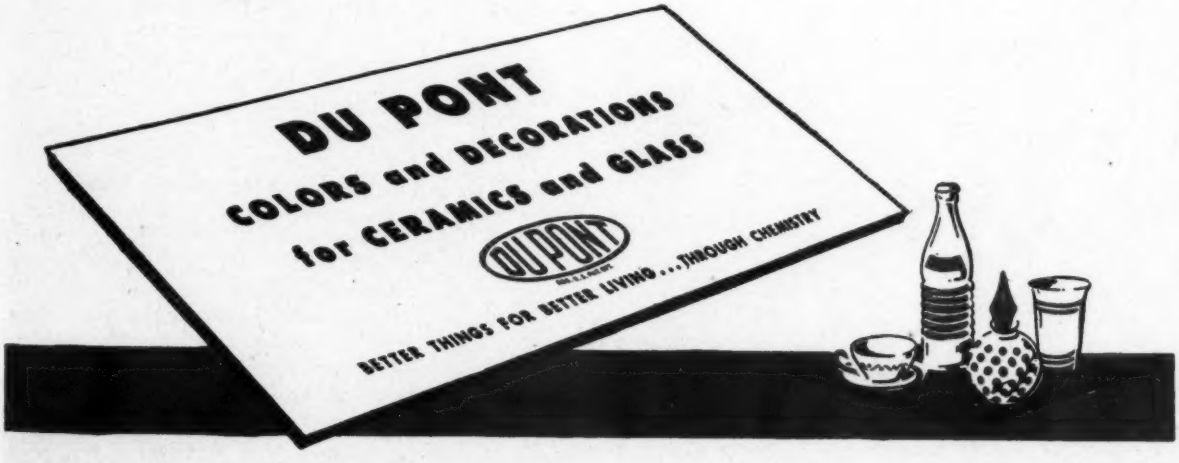
MATCHED TO ANY SHADE OR HUE

...DEPEND ON *DU PONT!*

For glass colors made under scientific control to meet your every requirement, depend on Du Pont. Standard—or exactingly matched to any shade or hue—Du Pont Glass Colors give smooth, even applications, adaptable to the heaviest of multi-layer designs. They fire to an even, high gloss, give clean sharp edges. Because they resist acid, alkali and sulfides, Du Pont colors stand up under constant, direct contact with foods. And they resist abrasion, stand up under repeated washing, sterilization and exposure to hot caustic solutions. Build quality into your product with Du Pont colors and decorations.

DU PONT LIQUID BRIGHT GOLD . . . A uniformly true gold that offers you good coverage, wide firing range. Effective and economical, too.

CONSULT US NOW! Du Pont Technical and Laboratory Service is ready to help you with your problems. Trial runs can be made in Du Pont Laboratories or on your own equipment. Du Pont can be your single source of standard and special match colors of all types, overglazes and underglazes, body slip and glaze stains and Squeegee Oil. Du Pont Colors are pretested before shipment for full color value. Get more data by writing: E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.



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to 1200°C during the next 4 hours, after which time the pot is ready for transfer to the melting furnace. In the heating stage the rise in temperature is controlled in accordance with relative speed with which the pot could be heated through certain temperature ranges without harm to the pot. The rates range from 15° to 50°C per hour as shown on Fig. 10.

(a) Change in length. (1) During heating. The linear expansion and contraction occurring during the heating of a specimen of raw pot body from 20° to 1,000°C and cooling back to 20°C are shown in Fig. 11. Most raw clays[8] have a small expansion to about 500°C, then contract as the endothermic reaction takes place. The pot body expands considerably more than the raw clay because of the 52½ per cent prefired clay or grog which it contains. However, a corresponding slight contraction was indicated between 525° and 550°C. Above 800°C the contraction was continuous to 1,000°C. The result of heating the specimen to 1,000°C and cooling back to 20°C was a shrinkage of 0.5 per cent. The time to reach the maximum temperature was about 8 hours and the specimen was removed from the cold furnace 16 hours later. The data used for the construction of Fig. 11 were the basis of the firing schedule for the pots.

(2) After heating. The shrinkage of the body, based on the dry length, after heating at least 1 hour at each temperature and cooling, was as follows for the average of three 1½ x 1½ x 4 in. specimens: 0.4 per cent from the dried unfired condition to 850°C; 1.9 per cent from 850° to 1250°C; 1.3 per cent from 1250° to 1400°C. Since the drying shrinkage of these same specimens was 3.0 per cent, it made the overall shrinkage 6.6 per cent. The overall shrinkage of the lining slip, after heating at 1400°C for three hours, was 8.1 per cent. The pot, on the other hand, had a total shrinkage of 5 per cent.

Fig. 9. The pot in the foreground has the rim only partially finished; the other three are completely finished with two showing the manner in which the stirring thimbles are supported during heating of the pot.

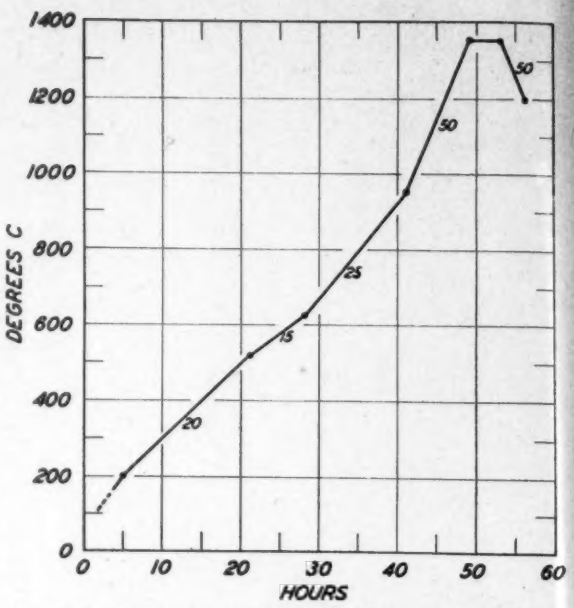


Fig. 10. The heating schedule for the raw pot. Figures adjacent to the curve indicate rates of temperature rise during different periods.

This value was obtained by measurements taken from the mold and the cooled pot after completion of the melting operation.

(b) Porosity and permeability. The porosity or absorption of the pot varied, depending on where the specimens for test were taken. Pyrometric cones distributed about the pot indicated a difference of heatwork of three cones between the bottom front and top back of the pot. Specimens taken below the shoulder of the pot at six places equally spaced around the circumference had a range in porosity from 19.7 to 22.7 per cent. These values corresponded to the position of the high and low pyrometric cones nearest which the specimens for test were taken. The specimens on which shrinkage data were obtained had an average porosity of 21.6 per cent after the 1400° C heat treatment.

A comparatively small change in the relative proportions of the different fractions of the grog made little significant difference in the porosity, but had a pronounced effect on the air permeability[9] of the fired pot body. For example, the apparent density of the grog mixture used in the pots for a number of years was about 1.197. A change in grog mixture resulting in a density of 1.26 caused a decrease in the porosity from 24.0 to 20 per cent approximately. The permeability, on the other hand, dropped from 0.100 to 0.038 cm^3/sec., indicating there was a decided change in the size of the pores. Fig. 12 shows a piece of the bottom of each of two pots after use and illustrates the extent of the penetration of the glass in the more permeable pot. The pots now manufactured have a gas

(*Continued on page* 204)

ANOTHER "THREE-YEAR" CORHART* ELECTROCAST TANK

A LITTLE over three years ago we published the story and operating data for a Corhart* flint-glass tank that had just finished a run of practically three years.

Today we are glad to report the results of that tank's successor—another "three-year" campaign just recently ended in which the melting and refining-end sidewalls, throat, doghouse and complete refining bottom of this unit were constructed with Corhart* Electrocast materials.

TOTAL DAYS	1,042
OPERATING DAYS	849
IDLE DAYS	193
MELTING AREA (SQ. FT.)	993
TOTAL TONS GLASS	141,029
CULLET RATIO	64.1%
TONS GLASS PER OPERATING DAY	166.1
TONS GLASS PER TOTAL DAYS	135.3
SQ. FT. PER TON PER TOTAL DAYS	7.3
SQ. FT. PER TON PER OPERATING DAY	6.0
TONS PER SQ. FT. PER LIFE	142

As we have said many times in the past, good production records are the result of good operation plus good refractories. Corhart* is glad to have had the opportunity of playing a part in this excellent performance.

*Not a product, but a registered trade-mark.

QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

(*Continued from page* 202)

permeability of approximately 0.04 cm^3/sec. In use they have slightly less resistance to thermal shock than the more permeable pots.

(c) Strength. The modulus of rupture of the raw pot body dried at 110°C and determined on 9 x 4 x 1½ in. slabs over an 8 in. span averaged 125 lb/in^2. After heating at 1400°C the average modulus was 1645 lb/in^2.

(d) Thermal Expansion. The total linear thermal expansion from room temperature to 1000°C of the pot body after having been heated to 1400°C was 0.425 per cent. As shown in Fig. 13, the expansion throughout that range was fairly uniform, the coefficient averaging 4.4 x 10^{-6} per degree.

Manufacture of Thimbles

The refractory thimbles, used for stirring the glass during fining, are supported during burning as illustrated in Fig. 9. A section of the thimble and mold is shown in Fig. 14. The wall of the thimble consists of the coarse-grained pot slip and a coating about ⅛ in. thick of the same fine-grained slip as is used to line the pots. The thimble weighs about 12¼ pounds and has a wall thickness of ½ inch, a length of 26½ inches, and an outside diameter below the collar of 4¼ inches which tapers to 3 inches near the closed end. A battery of a dozen molds is used. The thimbles are slip cast during the day, remain in the molds overnight and the surface finished the following day. The desired thickness of the low-porosity coating and the wall of the thimble are obtained by draining the excess slip from the mold as soon as each slip in turn reaches a predetermined gauge mark on a small reservoir of slip placed at the top or over the mouth of the mold. This required less than 10 minutes for the coating and approximately 2 hours for the wall. The mold must be filled with the coarse-grained slip immediately after the fine-grained slip has drained; otherwise knitting of the two layers may not occur. Also, the time of finishing must be correctly judged; if started too soon the thimble will collapse; if too late, the surface will have hardened to such an extent that it is impossible to develop a smooth surface.

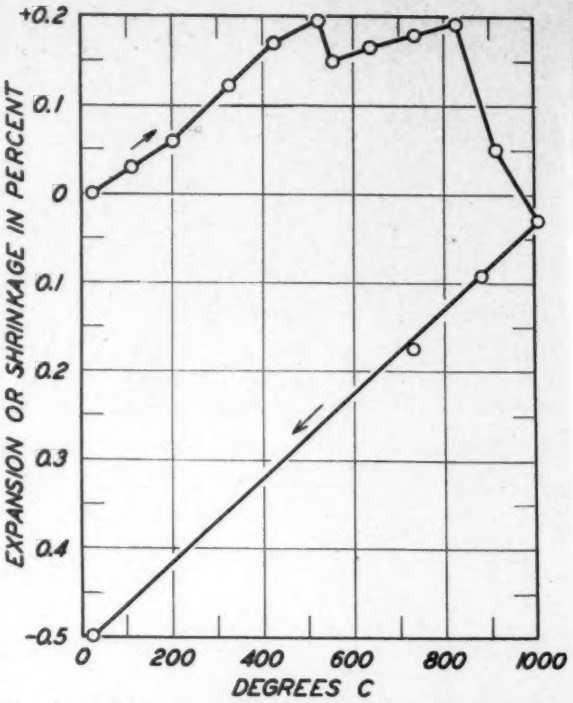


Fig. 11. The linear expansion and contraction occurring in a specimen of raw pot body during heating to 1,000°C and cooling back to 20°C.

General Remarks

The clay casting slip described in this paper is readily amenable to limited changes in composition and consistency without affecting the quality of the pot. How-

(*Continued on page* 208)

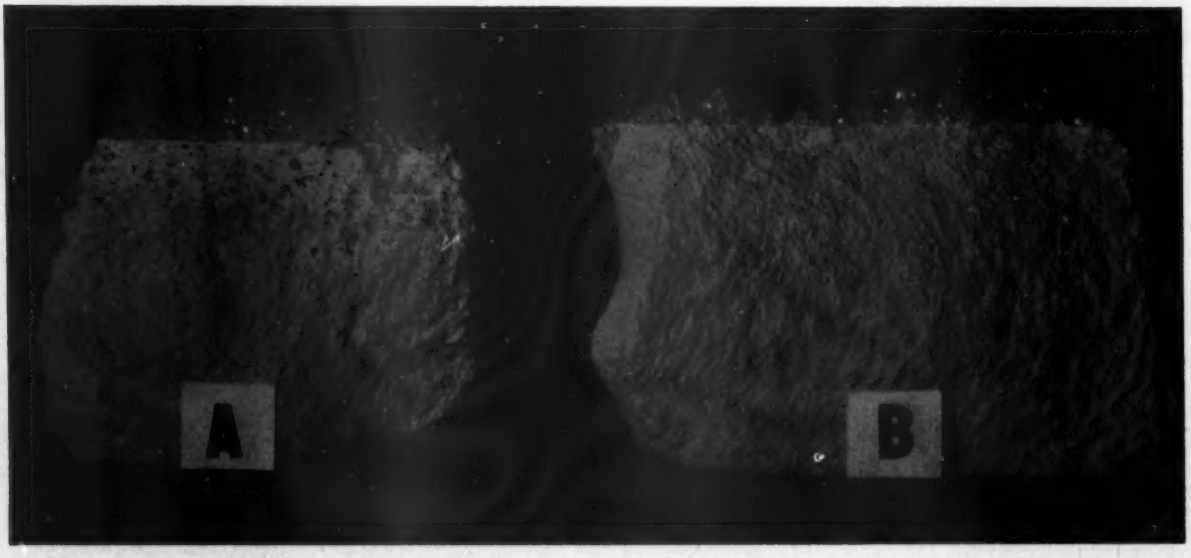


Fig. 12. A piece of the bottom of each of two pots, having an appreciable difference in gas permeability, in which borosilicate glass had been melted. The extent of the glass penetration in the more permeable pot A is clearly visible whereas pot B has no visible penetration.

Wherever hot gases need control . . .

Whether it's glass tank, boiler or furnace, superheated gases are quickly and surely put in their proper places by the Morgan Air Ejector. The powerful, continuous stream of cool air directed UPWARD through the venturi throat of the *short stack* draws the exhaust gases out of the furnace . . . causes them to mix with the cooler air within the short stack . . . rapidly discharges them into atmosphere!

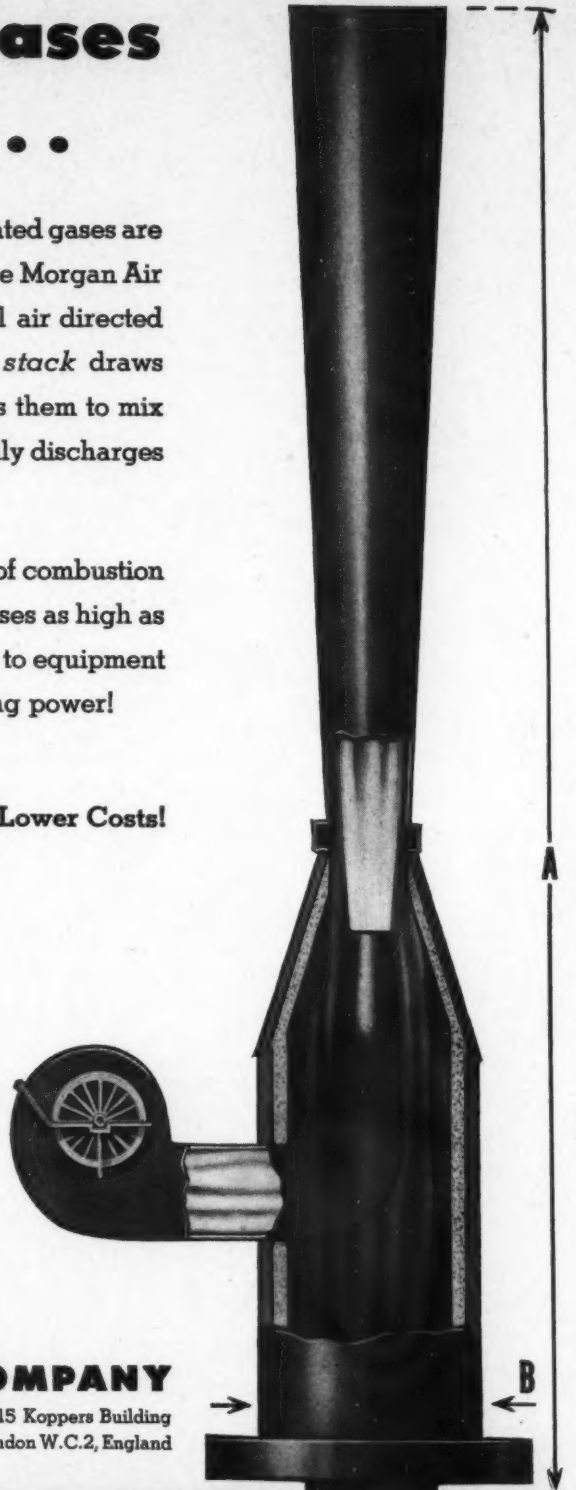
When you use a Morgan Air Ejector the products of combustion *do not pass through the fan* . . . that means gases as high as 3000° Fahrenheit can be handled without injury to equipment . . . without change in the even flow of exhausting power!

It all adds up to . . .
Increased Production, Better Production and Lower Costs!

MORGAN AIR EJECTOR SIZES
(Draft at Base One Inch of Water)

Size	Gallons Oil per hr.	Temp. of Exhaust Gas	Fan Motor H.P.	Dimensions A	Dimensions B
No. 1	50	1000°F	7½	20'–6"	3'–8"
No. 2	75	1000°F	10	23'–8"	4'–2"
No. 3	100	1000°F	15	27'–9"	4'–9"
No. 4	130	1000°F	20	31'–6"	5'–3"
No. 5	175	1000°F	20	34'–11"	5'–8"
No. 6	225*	1000°F	25	38'–6"	6'–2"

*Capacities available, up to 1000 gals. per hr.



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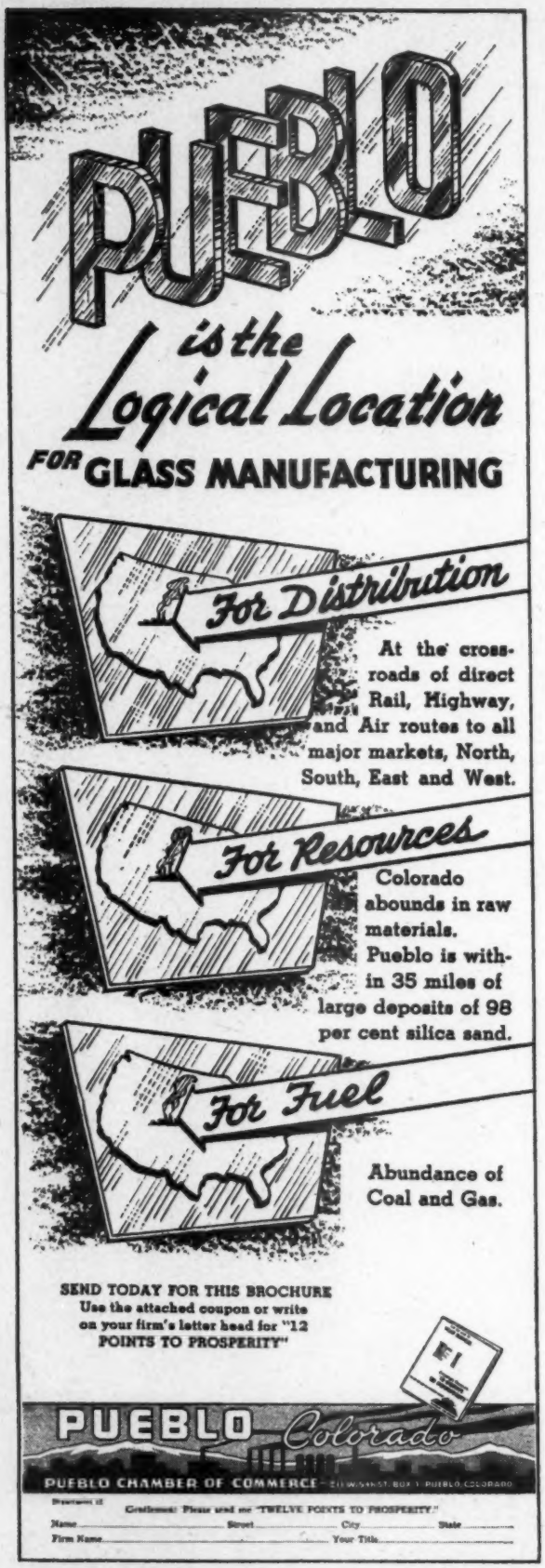
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RESEARCH DIGEST . . .

(*Continued from page* 191)

the original paper; namely, that the strength changes as measured by the energy required to give a prescribed breaking effect are a direct result of velocity changes.

For those interested in the use of engineering units, there is one point of interest in both the original paper and the note. The author uses feet and inches to express height of fall, kilograms to express weights, miles per hour to express velocity and kilogram-centimeters to express average energy. A ten-penny nail instead of a bolt would have been an innovation and would have introduced yet another unit of measurement.

Glass Densities by Settling Method

In the November, 1945 issue of the *Journal of the American Ceramic Society*, Mellen A. Knight describes a simplified sink-float apparatus and method for measuring the densities of lumps of glass. In brief, the method is as follows: Several lumps, of approximately two grams weight, of unknown density and one lump of glass of known density are placed in a heavy-liquids mixture contained in a test tube. The tube is immersed in a water bath that is heated automatically at a uniform rate; as the lumps settle, the temperature is noted at which each lump passes a reference line marked on the tube. The density of each unknown may be expressed simply in terms of the difference between its temperature and that for the standard lump, or these temperature differences can be converted to density differences or to absolute densities. The precision (reproducibility) of the measurements is represented by a standard deviation of approximately ± 0.0001 gm. per cc.

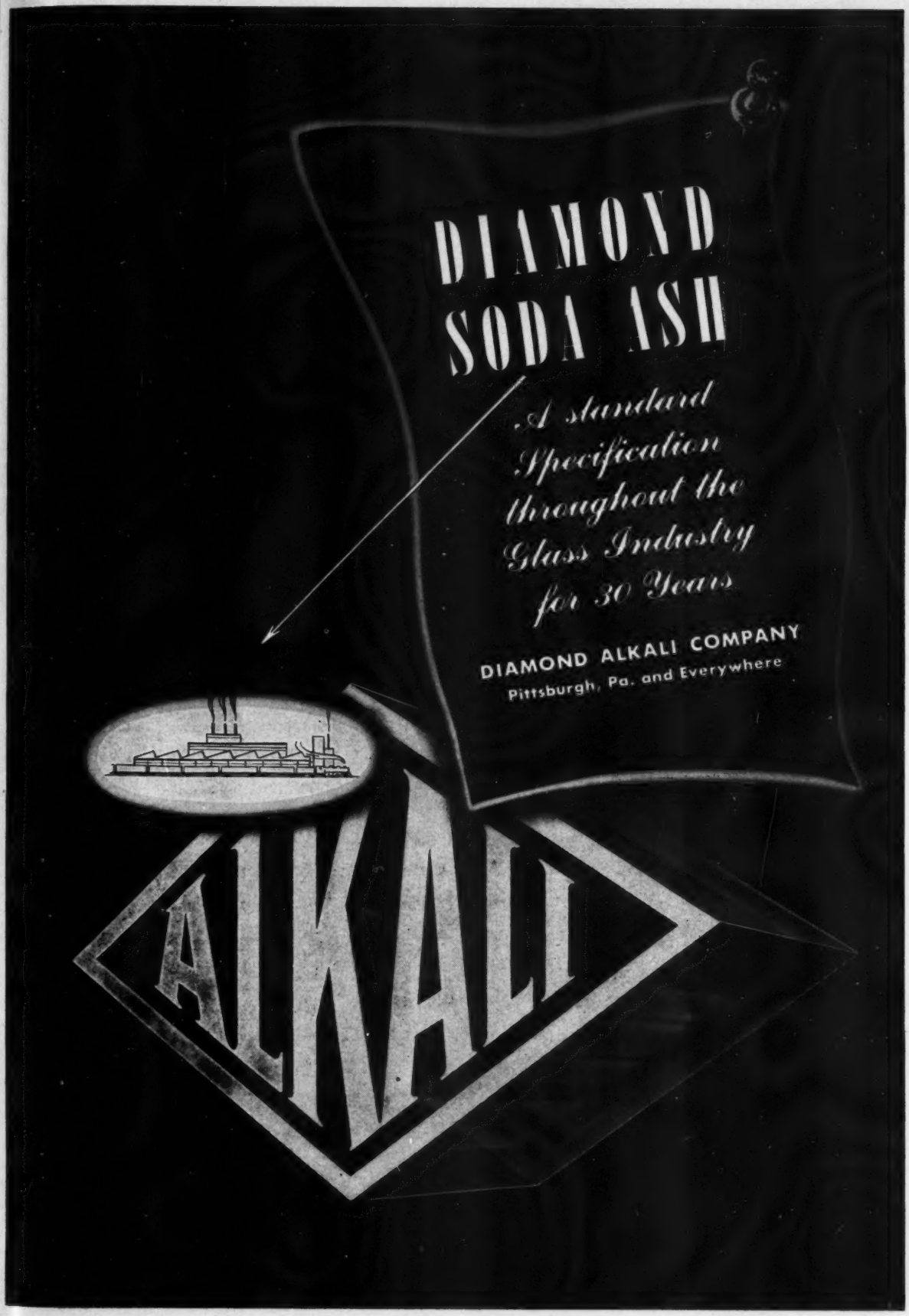
The method is rapid and convenient and requires a minimum of training of the operator. It is believed to be more practical for plant laboratories than the other available methods. It is especially applicable to measurement of daily densities for production control in glass plants and to trouble-shooting investigations of composition heterogeneities; large numbers of samples can be tested rapidly and precisely. Complete information as to sampling, operation and calculations is given.

AMERICAN GAS APPOINTMENTS

The American Gas Association recently announced the appointment of Eugene D. Milener as coordinator of general research and Mahlon A. Combs as secretary of the Industrial and Commercial Gas Section, succeeding Mr. Milener.

Mr. Milener joined the Association in 1928 in connection with the organization of research and development in industrial gas utilization. Before joining the A.G.A. staff, Mr. Milener was employed by the Consolidated Gas Electric Light and Power Company. His new duties consist of coordinating the general and technical utilization research of the Association.

Mr. Combs, who joined the Industrial and Commercial Gas Section last year, has had extensive experience in the gas industry. He has been connected with the Consolidated Gas Company, Maxon Premix Burner Company and American Gas Products Corp.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(*Continued from page* 204)

ever, at casting time it is especially desirable to have the slip at maximum fluidity consistent with minimum shrinkage of the dry product to obtain a pot relatively free from pores due to entrapped air and other defects. It is also desirable to proportion the various sizes of grog in such ratio as to obtain a finished body of low gas permeability but still having good resistance to thermal shock. There is a very general relation between permeability and porosity. However, apparently two bodies may have the same porosity, but because of a difference in pore size the permeabilty could be quite different. The porosity is, therefore, not a dependable indicator of permeability and not too much reliance should be placed on the former when changes in pot structure are contemplated.

The control of the air permeabilty is much more important in the case of the unlined pot than in the lined

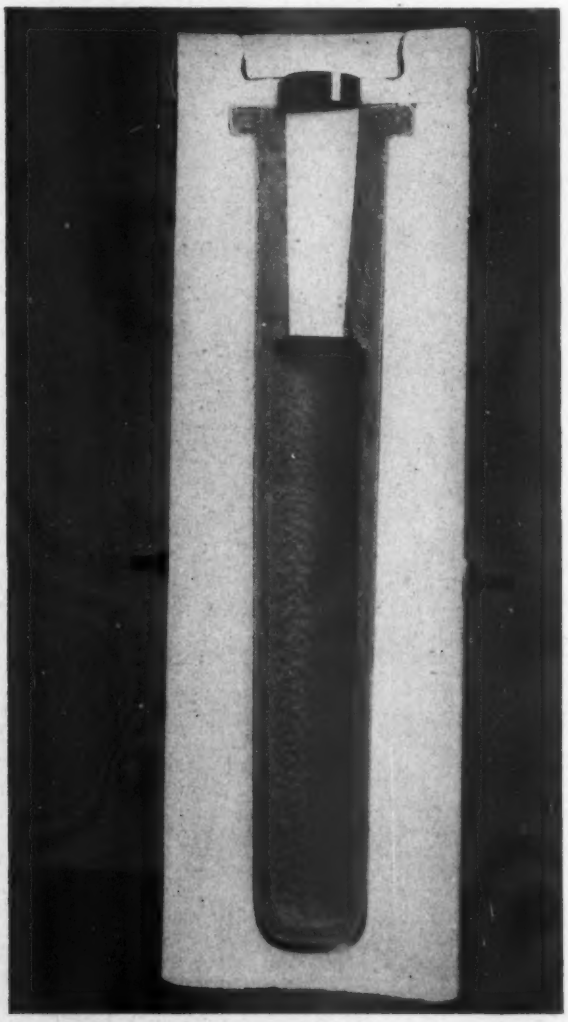

Fig. 14. Section of mold and thimble. The low porosity coating, the reservoir in position at the top for the fine-grained slip and also that for the coarse-grained slip near the base of the mold may be observed. The manner of locking the lid in position and that of inverting the mold by means of lugs to remove thimble are also shown.

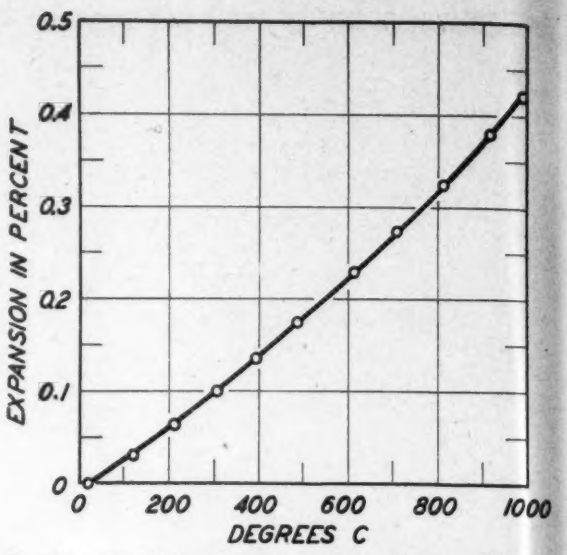

Fig. 13. The linear thermal expansion between 20° and 1,000°C of the pot body after having been preheated at 1400°C.

since in the latter the lining has a very low porosity especially effective in resisting attack by glass.

During the past 20 years numerous publications dealing with glasshouse pots have appeared. The majority of these deal with the handmade pot. However, many of the details of manufacture as well as the destructive action* of the glasses produced in the pots are common to both the slip cast and handmade variety. A number of references are, therefore, included in a selected bibliography[10].

*The report by Parsons and Insley referred to in reference [5] deals with the destructive action of slip-cast pots manufactured in the earlier war years before the many improvements in manufacturing and burning techniques were adopted.

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(*Continued on page* 214)

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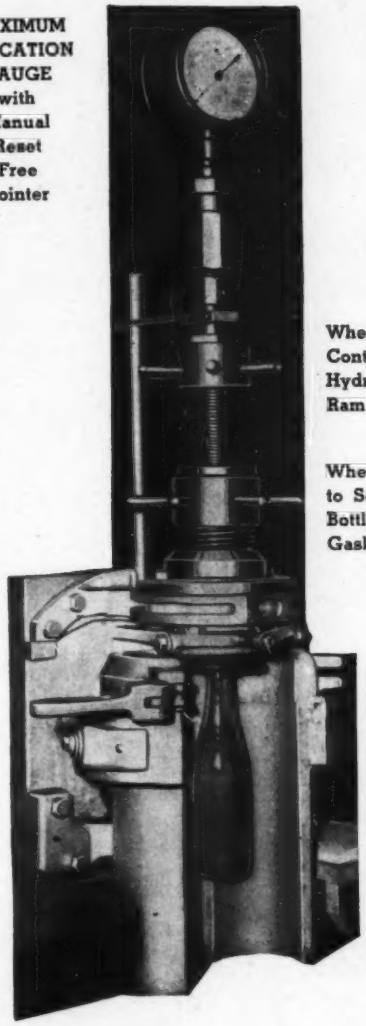

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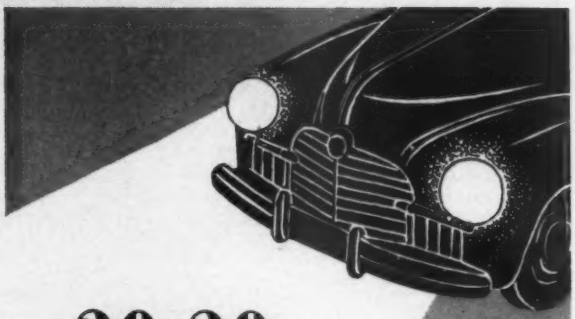

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ORGANIZATION MEETINGS OF A.C.S. SECTIONS

Two organization meetings of American Ceramic Society Sections were held early in March. These were the Philadelphia Section and the West Virginia Section.

Charles S. Pearce, Associate Secretary of the Society, was present at the Philadelphia meeting and, among other things, gave a short report on the convention plans for the Society's annual meeting to be held in Buffalo. He then introduced James Austin, Trustee of the Society, who presented the Charter to the new Section.

Officers for the new Section were then elected. They are Councilor, H. M. Kramer, Bethlehem Steel Co.; Chairman, H. A. Heiligman, E. J. Lavino Company; Vice-Chairman, G. B. Remmey, R. C. Remmey Sons Company; and Secretary-Treasurer, J. D. Clark, Foote Mineral Company.

Mr. Pearce was also present at the West Virginia meeting as was C. Forrest Tefft, President of the Society. Mr. Tefft spoke briefly on the need of ably trained personnel in the ceramic industries and then presented the charter for the West Virginia Section.

H. E. Simpson of Mellon Institute gave an illustrated talk on "Glass, Its Use in the Future". He described various applications of sheet glass and glass blocks as construction and decorative materials and showed many slides depicting what can be done with glass in this respect.

Officers for the new West Virginia Section were elected as follows: Councillor, M. H. Hunt, Porcelain Products, Inc.; Chairman, R. W. Ricker, Libbey-Owens-Ford Glass Co.; Vice-Chairman, K. O. Priddy, Barium Reduction Corp.; and Secretary-Treasurer, W. A. Koehler, West Virginia University.

PENN SALT NAMES WASHINGTON MANAGER

G. Webber Knight has been appointed manager of the Washington, D. C. office of the Pennsylvania Salt Manufacturing Company, according to a recent announcement.

In his new capacity which becomes effective immediately, Mr. Knight will look after all company interests in the nation's capital and will act as a clearing house in all Penn Salt matters involving both domestic and foreign government agencies. He has been with the company for 21 years in managerial positions.

PENN SALT NAMES NEW DIRECTOR

Alexander J. Cassatt, Vice President of the Western Saving Fund, was recently elected to the Board of Directors of the Pennsylvania Salt Manufacturing Company, according to a recent announcement.

Mr. Cassett is a Trustee of the Drexel Institute of Technology and a director of the Electric Storage Battery Company, the Pennsylvania Company for Insurance on Lives and Granting Annuities, the Fire Association of Philadelphia, Reliance Insurance Company, the Pennroad Company and the American Briquet Company.

• Frank G. Moore, traffic manager for the Pittsburgh Plate Glass Company's Columbia Chemical Division and the Southern Alkali Corporation, has been elected chairman of the traffic committee of the Manufacturing Chemists Association of the United States.

OWENS-CORNING PURCHASES LEASED PLANT

Owens-Corning Fiberglas Corporation has announced the purchase of the plant which it has operated under lease since 1943 in Huntingdon, Pa. The War Assets Corporation accepted the company's bid of $910,000 for the purchase of the plant.

The Reconstruction Finance Corporation recently accepted Owens-Corning's bid of $650,000 to purchase a 35-acre industrial property in Kansas City, Kansas.

Manufacturing equipment in the Huntingdon plant will be used to produce Fiberglas continuous filament yarns, while the Kansas plant is being equipped to manufacture Fiberglas building insulation and roofing materials, pipe wrap, industrial and equipment insulation and fine glass fibers.

BROWN INSTRUMENT NAMES INDUSTRIAL BRANCH MANAGERS

O. J. Richardson has been appointed industrial manager of the Brown Instrument Company division, Minneapolis-Honeywell Regulator Company, Detroit, Michigan.

Mr. Richardson has been with the company for the past 10 years and has served as sales engineer and in other capacities at the company's Cincinnati, Buffalo and Pittsburgh offices.

It has also been announced that George W. Brown has been appointed industrial manager of the Cincinnati office. Mr. Brown has been with the Philadelphia industrial division for the past nine years as sales engineer in Chicago, Louisville, Philadelphia and New York.

ARMSTRONG GLASS & CLOSURE DIVISION MANAGERS HOLD CONFERENCE

Expansion of sales of the Armstrong Cork Company's Glass and Closure Division was the keynote of a conference of all the Division's district managers held at Lancaster, Pa., in February. This was the first such conference since 1941.

H. W. Prentis, Jr., President, and other company officials addressed the conference on various phases of the company's policies and plans. A panel of Armstrong research chemists told about recent improvements in the manufacture of glass, closures, liners and discussed developments that can be expected in the near future.

JESSOP ELECTS FIRST VICE PRESIDENT

Harry Wilson, Jr., formerly vice president in charge of operations, has been elected first vice president of the Jessop Steel Company.

Mr. Wilson has been associated with the company for the past forty years in the capacities of general superintendent, works manager and vice president in charge of operations.

● A stock split-up has been announced by T. C. Werbe, President of the Lynch Corporation. It is proposed to increase and change the capital stock from 150,000 shares of $5 par common stock to 500,000 share of $2 par common. New shares to be sold will aid in negotiations for acquisition of expanded facilities. Funds will pay for an addition to the Toledo plant, to reduce bank loans and to carry increased inventories.

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A.C.S. RETURNS TO BUFFALO FOR ITS ANNUAL MEETING . . .

(*Continued from page* 183)

A comparison is given of the reductibility of silver, lead, antimony, copper and bismuth in borate, borosilicate, and phosphate base glasses.

10. Constitution of Extra Dense Flint Glasses. *By K. Fajans and N. J. Kreidl: (K. Fajans), Department of Chemistry, University of Michigan, Ann Arbor, Mich., and Glass Science, Incorporated, State College, Pa.; (N. J. Kreidl), Bausch & Lomb Optical Company, Rochester 2, N. Y.*

The formation of glass is favored by such properties of ions and molecules which are hindering the transition from their arrangement in the viscous liquid state to the thermodynamically, more stable crystalline state. In the case of network-forming oxygen ions, the favorable property is their strong binding and considerable deviation from spherical symmetry due to the two-sided strongly polarizing action of the neighboring cations B^{3+}, Si^{4+}, P^{5+}.

The interlinkage of the SiO_4, PO_4, BO_4, or BO_3 groups hitherto was believed to be a prerequisite of glass formation unless some other ion capable of substituting for silicon could partially take its place in similar groups. The stability of silicate, borate, phosphate glasses with very high lead content has been little understood because the large Pb^{++} ion could not be supposed to replace the small B^{3+}, Si^{4+}, P^{5+} as a network former. For the same reason, and being only doubly charged, it cannot be assumed to strongly polarize the O^{2-} ions.

A theoretical study of the polarization of cations by anions leads to a new picture of the constitution of extra dense flint glasses. The six S^2 electrons of Pb^{++} are easily polarizable and can be expected to be repelled and loosened in the glass by the surrounding anions. It can be shown that this deformation of Pb^{++} leads to a strengthening of its binding and to a decrease of its free orientation.

(The presentation of this paper was postponed when the Annual Meeting, 1945, was cancelled.)

11. Surface Tension of Some Optical Glasses. *By Leo Shartsis and Alden W. Smock: National Bureau of Standards, Washington* 25, D. C.

The surface tensions of a number of optical glasses made at the National Bureau of Standards have been measured by a modification of the anchor ring method. The flint glasses show a range of 210 to 230 dynes per cm. at 1300°C., the barium crowns about 260 to 310, while the other types of glasses had intermediate values. Most of the glasses had positive temperature coefficients of surface tension. The surface tension values found seem to increase with the length of time the glasses were held at high temperatures immediately prior to measurement. Positive rank correlation coefficients of statistical significance were found between seed quality of optical glasses and such factors as surface tension, pot attack, and amount of gas liberated during the melting process.

12. Effect of Composition on Knoop Hardness of Glass. *By A. E. Pavlish and I. Mockrin: Battelle Memorial Institute, Columbus* 1, *Ohio.*

Data are presented on the results of a systematic study of the effect of glass composition on the Knoop hardness of glass. The hardness of glasses in the alumina-boric oxide-silica-lime system, and the effect of substitution of various oxides for silica or lime are given. Beryllium oxide was found to be most effective in increasing the Knoop hardness of the particular glass studied. The hardness also was increased by the use of MgO, CeO_2, ThO_2, NiO, and Fe_2O_3.

13. Effect of Li_2O, BeO, CaO, La_2O_3, and ThO_2 on Refractive Index, Dispersion and Liquidus of Barium Crown Glass. *By O. H. Grauer, Z. Zabawsky, E. H. Hamilton, and C. H. Hahner: National Bureau of Standards, Washington 25, D. C.*

With a base glass containing 54 mole % SiO_2, 14 mole % B_2O_3, and 32 mole % BaO, five series of glasses were made in which Li_2O, BeO, CaO, La_2O_3, or ThO_2 was substituted on a mole equivalent basis for one of the constituents in the base glass. Four additional series were made in which B_2O_3 was substituted for SiO_2 on the same basis. Graphs are presented showing the effect of these substitutions on the refractive indices (n_D), dispersions and liquidus of the glasses.

14. Some Electron Microscope Pictures of Glass Surfaces. *Presented by N. J. Kreidl: Bausch & Lomb Optical Company, Rochester 2, N. Y.*

Not a formal paper; showing of pictures only.

15. Relation Between Inelastic Deformability and Thermal Expansion of Glass in Its Annealing Range. *By Arthur Q. Tool: National Bureau of Standards, Washington 25, D. C.*

It has been shown previously that a close relation exists between the inelastic deformability and the extraordinary thermal expansion and other heat effects of glass in its annealing range. An equation (see A. Q. Tool, *Bull. Amer. Ceram. Soc.* **21** [4] 13 (1942)) to express this relation was developed on the assumption (1) that superheating and undercooling cause elastic molecular strains that are not compatible with an equilibrium condition and (2) that the relaxation of these strains is controlled by the ordinary inelastic deformability of a glass. Results obtained by applying this equation to experimental data indicate that the viscosity of a glass depends not only on the actual temperature but also on the degree of superheating or undercooling.

It has now been found that the equation, when modified according to this indication, applies satisfactorily to that part of experimental expansion curves that is entirely within the annealing range. Furthermore, discrepancies between computed and experimental results at temperatures below this range indicate that glass at such temperatures ceases to be a purely viscous liquid and becomes a plastic material. This experience agrees with that obtained by attempting to anneal glass at very low annealing temperatures.

16. Physical Properties of Glass Fibers. *By William H. Otto and Robert B. Taylor: Owens-Corning Fiberglas Corporation, Newark, Ohio.*

A summary of recent measurements on the physical properties of glass fibers is given; also included are data on the effect of several postforming conditions on the strength and other properties of the fibers. Some of the properties of plastics reinforced with high-strength glass fibers are mentioned.

17. Effect of Heat-Treatment Near Liquidus Temperature on Homogeneity of Soda-Lime-Silica Glass. *By R. L. Tiede and F. V. Tooley: Owens-Corning Fiberglas Corporation, Newark, Ohio.*

A study was made of the rate of change of homogeneity of a soda-lime-silica glass in the vicinity of the liquidus temperature. One of the main objects was to determine if, by means of the centrifuge-density spread technique, a rate of segregation could be measured on a glass heat-treated below the liquidus temperature for various periods of time.

Wednesday Afternoon, May 1, 2:00-4:30 P.M. Chinese Room

18. Ultraviolet Transmission in Vycor Brand Glasses. *By Martin E. Nordberg: Corning Glass Works, Corning, N. Y.*

The transmission of Vycor brand glasses, for short-wave ultraviolet light, is compared with certain commercial glasses and fused silica. The loss in transmission, after prolonged exposure to ultraviolet, is discussed; this solarization effect is very small in the Vycor glasses.

19. Crystal Growth and Solution in Glasses. *By Howard R. Swift: Libbey-Owens-Ford Glass Company, 1701 E. Broadway, Toledo 5, Ohio.*

Experiments were conducted on glasses of commercial interest which included the development of methods of measuring the linear rate of crystal growth and linear rate of crystal

solution, and a study of surface crystallization. A method of studying interdiffusion of two glasses of similar composition is described.

20. Effect of Magnesia and Alumina on Rate of Crystal Growth in Some Soda-Lime-Silica Glasses. *By Howard R. Swift: Libbey-Owens-Ford Glass Company, 1701 E. Broadway, Toledo 5, Ohio.*

Measurements were made of the rates of crystal growth in a series of glasses with 74% SiO_2, 16% Na_2O, and 10% (CaO + MgO), the MgO replacing the CaO in 2% steps; and in a series of glasses with 17% Na_2O, 12% CaO, and 71% (SiO_2 + Al_2O_3), the alumina replacing the silica in 2% steps up to 8% Al_2O_3. A study was also made of the rate of crystal solution in the series with variable alumina. The results were explained qualitatively by considering the viscosity and liquidus temperature changes of the glasses as the composition varied.

21. Effect of Water Content on Infrared Transmission of Simple Glasses. *By Anna J. Harrison: Corning Glass Works, Corning, N. Y.*

Infrared-transmission studies on fused SiO_2, B_2O_3, and $Na_2O \cdot 2\ B_2O_3$ indicate that dissolved water is responsible for the absorption band appearing in the region of 2.8 microns.

22. Character of Flow Produced in Molding Thermoplastics by Typical Glass Type Methods. *By James Bailey: Plax Corporation, Hartford, Conn.*

If polystyrene plastic is heated to between 200° and 350°F. and forced to flow by the application of pressure, its molecules become orientated in the direction of flow. If the temperature is now dropped, the orientation becomes permanently frozen in and the plastic may be sawed into sections and the flow lines studied at leisure. Many operations common to glass practice may be studied in this way. It is possible to simulate crystal structure and to produce pieces having very beautiful color patterns in polarized light.

American Society for Testing Materials, Committee C-14
Chairman: Louis Navias: General Electric Company, Schenectady 5, N. Y.

Subcommittee I: Nomenclature and Definitions. By F. C. Flint: Hazel-Atlas Glass Company, Washington, Pa.

Subcommittee II: Chemical Analysis. By G. E. F. Lundell: National Bureau of Standards, Washington 25, D. C.

Subcommittee II: Chemical Analysis. Washington 25, D. C.

Subcommittee III: Chemical Properties. By J. F. Greene: Kimble Glass Company, Vineland, N. J.

Subcommittee IV: Physical and Mechanical Properties. By J. T. Littleton: Corning Glass Works, Corning, N. Y.

Subcommittee V: Thermal Properties. By E. W. Tillotson: Mellon Institute, Pittsburgh 13, Pa.

Subcommittee VI: Glass Construction Block and Tile. By J. P. Staples.

Subcommittee VII: Glass Containers. By W. R. Lester: Maryland Glass Corporation, Baltimore 30, Md.

Subcommittee VII, Section A: Pharmaceutical Containers. By F. C. Flint.

Subcommittee VIII: Flat Glass. By D. E. Sharp: Libbey-Owens-Ford Glass Company, Toledo 1, Ohio.

Nominating Committee Report

Other Business

23. Lead Nickel Glass of Controlled Chemical Durability for Storage Battery Use. *By F. J. Williams and J. A. Orsino: National Lead Company Research Laboratories, 105 York St., Brooklyn 1, N. Y.*

The addition of very small amounts of soluble nickel salts to the electrolyte of a lead storage battery markedly decreases the end of charge voltage. This effect, however, is

(*Continued on page* 215)

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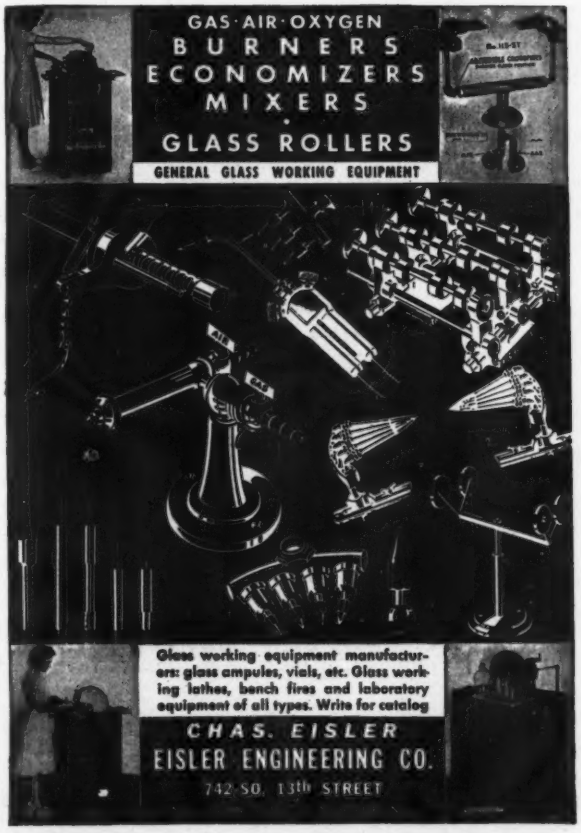
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SLIP CASTING OF CLAY POTS . . .

(*Continued from page* 208)

W. J. Rees, Refractories for the glass industry, Glass 4, 468 (1927).
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DIELECTRIC MELTING OF GLASS IN FRANCE . . .

(*Continued from page* 184)

and the glass fined at 1200°C (2192°F) for an additional two hours.

The advantages of dielectric heating include: 1. In contrast to the other electric furnaces no pre-heating is required. Although W at room temperature is small, the heat evolved, especially in presence of water, is sufficient to raise the temperature. 2. There is no contact between the electrodes and the glass charge and, consequently, no possibility of contaminating the glass by the electrode material. 3. If the material of the pot is properly selected, the glass during the whole process remains hotter than the pot. This reduces the contamination of glass by the refractory and extends the lifetime of the pot. 4. The dielectric furnace shares with other electric furnaces the advantage of a free choice of the atmosphere in the furnace. In gas or oil heated furnaces the atmosphere is of course that of the combustion products. 5. The heating control is very easy. It requires only a regulation of the input voltage V. 6. Small units are as economical as big ones, since the heat does not come from outside but is generated where it is needed.

There are, however, two important difficulties: 1. It has already been mentioned that the ideal refractory material for pots has not been found yet. The pot becomes very hot and must be heat-insulated to prevent an excessive waste of energy. 2. High-frequency electric energy is expensive. The energy yield of high-frequency generators never reaches 70 per cent, so that 30 per cent of the energy paid for is lost in one step. This consideration is so important that dielectric heating cannot be expected to compete with the usual furnaces for large scale production of relatively cheap glass. However, for optical and other high quality glasses it appears very promising.

So far dielectric heating has been considered in its application to making and fining glass. But it can be used also for jointing glass to glass. In Descarsin's original paper a detailed description is given of two machines sealing glass pinches to bulbs of radio tubes and electric lamps. The glass is heated by dielectric losses. A sharp localization of heating is easy in this method. It has been pointed out already that dielectric heat is evolved preferably in the hottest spot. The parts to be sealed are pre-heated with a gas flame and placed in the high-frequency field, and the preheated areas become even hotter while the cool areas remain cool.

A.C.S. RETURNS TO BUFFALO FOR ITS ANNUAL MEETING . . .

(*Continued from page* 213)

fugitive, disappearing in a few cycles. A lead-nickel-silicate glass was developed which, when incorporated in a battery, makes the effect on voltage permanent by continually supplying nickel ions to the electrolyte and, moreover, improves the cold capacity of the battery during its life. Advantage was taken of current knowledge of the chemical durability of glass in the experimental work.

WHEELCO ADDS TO ENGINEERING DEPARTMENT

In a recent announcement by Wheelco Instruments Company, it was revealed that Francis H. Beaupre and Bruno H. Ramthun have been added to the company's application engineering department.

For the past four years, Mr. Beaupre has been foreman in the instrument departments at Twin Cities Ordnance and the Garfield Division of the Houdaille Hershey Company. He has over four years experience in the operation of instrument departments responsible for the engineering, installation and servicing of all makes of industrial process instruments used on a broad variety of applications.

Mr. Ramthun, prior to joining the U.S.N.R., was in the employ of the Brown Instrument Company and the Minneapolis-Honeywell Regulator Company as an instrumentation engineer, specializing in the field application of all products made by the two companies for every type of commercial and industrial process.

These men will serve in a liaison capacity with the sales application, engineering design, research and production department on technical matters pertaining to the details and use of Wheelco instruments and associated accessories.

PITTSBURGH CORNING EXPANDS FOAMGLAS FACILITIES

It has recently been announced that the Pittsburgh Corning Corporation is planning a $300,000 expansion of existing facilities for the manufacture of Foamglas, a glass insulation material, at its Port Allegany plant.

Construction of a new plant to house a melting furnace is expeeted to begin soon. Additional buildings designed to house batch handling and cullet crushing equipment will be erected at the same time, according to the announcement.

The plant is now staffed by 475 workmen and it is predicted that 100 additional workers will be employed when the plant expansion is completed. Contractor on the construction work is the Toledo Engineering Company of Toledo, Ohio.

OPERATIONS BEGIN AT GEM GLASS COMPANY

Operations began at the new Gem Glass Company in Fairmount, Indiana, on March 16 according to a recent announcement. The initial contract for the new concern will be one for bases for electric lamps.

The plant will operate twenty-four hours a day with the glass to be worked eight hours and the melting process taking 16 hours.

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